PROCEEDINGS

OF THE

AMERICAN PHILOSOPHICAL SOCIETY

HELD AT PHILADELPHIA

FOR

PROMOTING USEFUL KNOWLEDGE.

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AMERICAN PHILOSOPHICAL SOCIETY,

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VOL. XXXIII. JANUARY, 1894. No. 144.

January 5, 1894.

The annual election for Officers and Councilors was held this afternoon between the hours of 2 and 5 P.M. The result was submitted to the Society at the evening meeting by the officers of the election.

Stated Meeting, January 5, 1894.

President, Mr. FRALEY, in the Chair.

Prof. W. H. Appleton, a lately elected member, was presented and took his seat.

Correspondence was submitted as follows:

A circular was received from the Nederlandsche Maatschappij ter bevordering van Nijverheid, Harlem, offering a prize for 1894.

Accessions to the Library were reported from the Australasian Association for the Advancement of Science, Sydney; Institut Egyptien, Cairo, Egypt; Anthropological Society, Tokyo, Japan; Friesch. Genootschap van Geschied, etc., Leuwarden; Société R. de Géographie, Antwerp, Belgium; Société Hongroise de Géographie, Budapest; Siebenbürgische Verein

für Naturwissenschaften, Hermanstadt, Transylvania; Physiologische Gesellschaft, Messrs. R. Friedländer und Sohn, Berlin, Prussia; Verein für Erdkunde, K. Sächs. Alterthums-Verein, Dresden, Saxony; K. Leopoldinisch-Carolinische Deutsche Akademie der Naturforscher, Halle a. S., Prussia; Deutsche Seewarte, Hamburg, Germany; K. Sächs. Gesellschaft der Wissenchaften, Leipzig; K. B. Akademie der Wissenschaften, Munich, Bavaria; Society of Arts, Royal Astronomical Society, Editors of *Nature*, Royal Society, Meteorological Society, Prof. Joseph Prestwich, London, Eng.; Literary and Philosophical Society, New Castle-upon-Tyne, Eng.; Geological Survey of Canada, Ottawa; Bureau of Statistics of Labor, Athenæum, The family of the late John Pickering, Boston, Mass.; Harvard College, Mr. A. McFarland Davis, Cambridge, Mass.; American Antiquarian Society, Worcester, Mass.; The Travelers Insurance Company, Hartford, Conn.; Editor of the *Archæological Magazine*, Meriden, Conn.; Yale University, Editors of *American Journal of Science*, New Haven, Conn.; American Institute of Electrical Engineers, Mathematical Society, Meteorological Observatory, Editor of the *Popular Science Monthly*, Prof. J. A. Allen, New York, N. Y.; Free Public Library, Jersey City, N. J.; Geological Survey of New Jersey, Trenton; American Chemical Society, Easton, Pa.; Editors of the *Medical News*, College of Pharmacy, University of Pennsylvania, Messrs. Julius F. Sachse, Henry Phillips, Jr., Philadelphia; Editor of the *American Chemical Journal*, Baltimore, Md.; U. S. Geological Survey, Hydrographic Office, Commissioner of Labor, Bureau of Statistics, Washington, D.C.; State Board of Health, Nashville, Tenn.; Academy of Science, St. Louis, Mo.; Geological Publishing Company, Minneapolis, Minn.; Kansas Academy of Science, Topeka, Kans.; Academy of Science, Tacoma, Wash.; Agricultural Experiment Stations, Pennsylvania State College, Knoxville, Tenn., Madison, Wis, Laramie, Wyo; Sociedad Cientifica "Antonio Alzate," Observatorio Astronomico Nacional de Tacubaya, Mexico, Mex.; Société Scientifique du Chili, Santiago.

Photographs for the Society's Album were received of Messrs. R. Meade Bache and Thomas M. Cleemann.

The following deaths were announced:

George de Benneville Keim, Philadelphia, December 18, 1893, æt. 64.

Dr. Charles M. Cresson, Philadelphia, December 27, 1893, æt. 66.

Dr. Dionys Stuer, Vienna, October 9, 1893.

The President having been authorized to appoint suitable persons to prepare the usual obituary notices, subsequently appointed Dr. Daniel G. Brinton for Mr. Keim.

The officers of the election held this afternoon pursuant to the laws of the Society reported the following members had been elected as Officers and Council of the Society for the ensuing year.:

President.

Frederick Fraley.

Vice-Presidents.

E. Otis Kendall, W. S. W. Ruschenberger, J. P. Lesley.

Secretaries.

George F. Barker, Daniel G. Brinton, Henry Phillips, Jr., George H. Horn.

Curators.

Patterson DuBois, J. Cheston Morris, R. Meade Bache.

Treasurer.

J. Sergeant Price.

Councilors for Three Years.

William P. Tatham, George R. Morehouse, Samuel Wagner, William C. Cattell.

Councilor for Two Years, in place of Thomas H. Dudley, deceased.

Henry Hartshorne.

Mr. Henry Phillips, Jr., was renominated for Librarian, and the nominations were closed.

Dr. Daniel G. Brinton read a paper on "Nagualism."

Mr. Lyman read a paper on "The Age of the Newark Brownstone."

Dr. Cope presented a communication on the fishes of Rio Grande do Sul.

Pending nominations Nos. 1268, 1269, 1270, 1271, 1272, 1273, 1274 were read.

The report of the Finance Committee was presented and the appropriations for the year were passed.

The Michaux Committee presented the following report and resolution, which were adopted:

The Michaux Committee of the American Philosophical Society respectfully reports, that at a meeting held on December 14, 1893, a letter was received from Dr. J. T. Rothrock enclosing list of the time and subjects proposed for the Fifteenth Course of Lectures for 1894, given under the auspices of the American Philosophical Society:

MONDAY EVENINGS.

Jan. 22. Pennsylvania Forests and Forest Trees (illustrated).
" 29. Protection of Pennsylvania Forests.
Feb. 5. Waste of Pennsylvania Forests (illustrated).
" 12. Possibilities of Forest Restoration.
" 19. Legal Relations of our Forests.
" 26. Trees in Cities and Towns (illustrated).
March 5. Waste Lands of the Commonwealth (illustrated).

The Lectures will be delivered in the Pennsylvania University Building, which has been kindly tendered to him for the purpose. He estimates the cost of the lectures at $240.

The Committee approved of Dr. Rothrock's proposition, and asks for the passage by the Society of the following resolution:

"*Resolved*, That the sum of two hundred and forty dollars be appropri-

ated out of the income of the Michaux Fund for the expenses of the Fifteenth Course of the Michaux Forestry Lectures by Prof. J. T. Rothrock."

By order of the Committee,

J. SERGEANT PRICE, *Secretary.*

The Librarian reported that Dr. Elliott Coues had returned personally all the Lewis and Clarke manuscripts borrowed by him; that the same were correct in number and condition; that Dr. Coues had arranged them in a most excellent and careful manner, so as to facilitate all future reference; in fact, that they were in much better condition than when loaned by the Society.

The Treasurer was authorized to receive from the city of Philadelphia the sum of $3000 due January 1, 1894, and to sign proper quittances therefor.

And the Society was adjourned by the President.

Age of the Newark Brownstone.

By Benj. Smith Lyman.

(*Read before the American Philosophical Society, January 5, 1894.*)

There seems to be reasonable ground for doubt whether the rock beds of the Newark, N. J., brown building stone quarries belong even to the Mesozoic, as they have generally been thought to. In spite of the unfavorable character of the sandstone for preserving fossils, it has yielded a number of specimens, and the identification of at least two species has been attempted. In the *New Jersey State Geological Report* for 1879, p. 26, the late deeply lamented State Geologist, Prof. Cook, speaks of certain fossils at the closely adjacent Belleville quarries, evidently in the same sandy beds, as follows, citing the unexcelled authority of Lesquereux:

"At the Belleville quarries thin seams of coal and impressions of the stems and branches of plants are not uncommon. A fragment of the stem of a plant with surface markings like the Lepidodendron was found, and is now the property of Mr. David Hitchcock, of Orange. It is a very plainly marked, flattened stem, eight inches long, four and one-half inches wide, and one and one-half inches thick. Photographs of this

were taken and sent to Prof. L. Lesquereux, of Columbus, Ohio. He returns the following answer:

"'The photographs are sufficient, if not for specific determination, at least for positive reference of the specimens to Lepidodendron. Even I should say that the specimens represent *L. weltheimianum* Presl as distinctly as a specific representation can be made upon a decorticated trunk of Lepidodendron. *L. weltheimianum* is a leading species of the old red sandstone found here, as in Europe, from the subcarboniferous measures down to the Devonian, while until now we do not have any remains of Lepidodendron of any kind from the upper coal measures (Permo-carboniferous), or from higher up than the Pittsburg coal.

"'*L. weltheimianum* is recorded only once from the true coal measures; this by Eichwald, from the Carboniferous sandstone of Russia. But European authors, among others Goeppert, doubt the identity of the Russian species with *L. weltheimianum*, which is moreover extremely variable, and has been described already under about thirty different names.'

"Another fragment [Prof. Cook adds] has since been obtained from the same quarries by Dr. Skinner, of Belleville, and is now in our possession. It is seven inches long, five and one-half inches wide, and one and one-half inches thick, and is as plainly marked as the first. Other and smaller specimens somewhat like the above have also been found in the quarries in Newark. If these fossils are sufficient to determine the geological age of these beds, they put it in the upper Carboniferous, at least, which is lower than has heretofore been claimed for it. A larger and more complete collection of such fossils must be made if possible.

"Vegetable impressions are found in large numbers at the quarries of Mr. Smith Clark, of Milford, but most of them are fragmentary and indistinct. Those which can be seen plainly enough for identification resemble the Equisetum and some coniferous plants. They are evidently much newer than the fossils at Newark and Belleville."

It is not to be wondered at that the very sagacious Prof. Cook should have perceived this great difference in age on even so cursory an examination; for the Newark brownstone is at least some nine thousand feet lower geologically than the Milford beds, a part of the Perkasie shales of Pennsylvania. Few species indicating the geological age have been reported from the Milford beds; but from the horizon of the Gwynedd and Phœnixville dark shales, far below those of Milford, and quite above the Newark beds, appear to have come most of the fossils in Pennsylvania, Virginia, North Carolina, and elsewhere, that have been thought to indicate the Rhætic age of all the older Mesozoic rocks of those States.

So fixed has become the impression of the Mesozoic age of all the beds that have hitherto commonly been grouped together under the name of the American New Red, and many other names, that it may even possibly have caused some bias in the minds of paleontologists in their determination of more or less doubtful fossils; though Lesquereux seems not to have been fettered by such a prejudice to the extent of blindness to otherwise

clear indications. Prof. William M. Fontaine may have been guided by equally clear indications, but his expressed argument does not seem perfectly sound when he says of a "New Red" fossil described and figured by Emmons as a Lepidodendron, and without pointing out what else it is: "These impressions are, of course, not those of Lepidodendron, as this plant does not exist in the Mesozoic." That would decidedly seem to be begging the question as to the age of the fossil. Newberry appears also to have been possibly influenced by the same assumption.

In has, in fact, been generally, but perhaps too superficially, assumed from the predominance mainly of a red color, and the absence of notable unconformities in the beds of the so-called New Red, and the lack of numerous convenient fossil indications, that the beds all belonged to one formation of no wide paleontological range, and consequently of no very great thickness. Now that our Pennsylvania investigations prove beyond a doubt that the total thickness is at least some twenty-seven thousand feet, the presumption is rather that the beds should be of very diverse geological age; and even it should not seem surprising if the lower ones, including the Newark brownstone, should prove to be of Paleozoic age.

Lesquereux's very positive, unhesitating recognition of the Lepidodendron would of itself make it highly probable that the brownstone was at least as old as the Carboniferous; and somewhat confirmatory wholly independent fossil evidence has been found in Pennsylvania. Several years ago Mr. S. E. Paschall, of Doylestown, pointed out to Prof. Henry Carvill Lewis certain calamite fossils that had been found by Mr. John S. Ash half a dozen miles easterly from Doylestown, just north of the old Paleozoic island, so to speak, and within the limits of the supposed Mesozoic, and now known to be a couple of thousand feet geologically below the brownstone beds. Lewis thought the calamite might be of Permian age. With much search Mr. Ash succeeded in finding a specimen that contained two joints with the whole internode, some twelve or fifteen inches long, and some eight inches or more broad, and it was sent to Lesquereux for identification. Other affairs through the short remainder of his busy life prevented Lesquereux from communicating any result of his examination, and the specimen has not yet been recovered. But Mr. Paschall has a less perfect fragment ten inches long, indicating a calamite of at least six inches in breadth, with a single joint at two inches from one end. He says there are other better specimens at the Academy of Natural Sciences.

The only two recorded fossils, both plants, that have been supposed to be identified beyond doubt, from the Newark quarries, are the *Dioönites longifolius* and *Clathropteris platyphylla*, mentioned by Newberry in his Monograph xiv, of the *U. S. Geological Survey*, on "The Fossil Fishes and Fossil Plants of the Triassic Rocks," etc., 1888, pp. 92 and 94. Fontaine speaks of the *Dioönites longifolius* among the North Carolina fossils, *U. S. Geological Survey*, Monograph vi, 1883, p. 111, judging merely by a description and figure of Emmons', as probably nearly allied to *Zamites*

proximus from the Rajmahal group of India (Jurassic) ; and in describing the *Clathropteris platyphylla* from the Virginia coal measures (probably corresponding in age to the Gwynedd and Phœnixville shales, and decidedly later than the Newark beds) points out (p. 56) several differences between it and the European Jurassic plant, with which, on the whole, he thinks it should be associated. Newberry (Monograph xiv, p. 94) says that fragments of the *Clathropteris platyphylla* have been obtained, though only rarely, from the beds of Newark ; but the one he figures is from Milford, N. J., that is, some nine thousand feet above the Newark beds.

Newberry mentions (p. 86) also an imperfect Newark fossil that, "in reviewing the literature of the Triassic flora" (an expression that seems to show his inclination to assume *a priori* that the Newark beds were necessarily Mesozoic), he found to resemble the *Equisetum meriani;* but he candidly adds : "Until the fructification of these Equisetoid plants shall be found which will permit a better comparison with those of older and later formations, it is a useless expenditure of time to discuss the question whether they are species of *Calamites* which have survived from the Carboniferous age, are true *Equiseta*, or are species of an extinct genus of that family."

Newberry further speaks of a fossil tree trunk found frequently in the sandstone quarries of Newark, resembling *Lepidodendron*, adding in regard to the idea of its being one : "This is a manifest error. *Lepidodendron* did not pass from the Carboniferous to the Mesozoic age." Evidently he took it in advance for granted that the beds of Newark could not be older than Mesozoic. It is not unlikely these very fossils are of the species so readily identified by Lesquereux with the *Lepidodendron*. Newberry thinks they are probably a *Palissya;* and Fontaine mentions *Palissya indica*, a plant of the Rajmahal group, as occurring in North Carolina.

Apparently no other fossils have been recorded as coming from Newark ; and it is seen that only two of them have been identified with any approach to certainty. Moreover, neither of the two would seem to be so closely like the nearest European and Indian forms as altogether to preclude the possibility of their being of very different age from them, especially considering their geographical remoteness.

Rogers, in his *Final Report on the Geology of Pennsylvania*, 1858, Vol. ii, p. 507, suggests the possibility of finding Permian fossils among the highest rocks of Greene county, in the southwestern corner of the State ; and Stevenson, in his *Report of the Second Geological Survey of Pennsylvania*, 1876, shows (p. 35) that the highest known rocks there are red shales. Whether Carboniferous or Permian, it is by no means inconceivable that they may prove to be contemporaneous with the Newark beds.

The Canadian geologists have found that much of the formerly so-called Trias of Prince Edward Island, New Brunswick and Nova Scotia is really Permian, Permo carboniferous, or even Carboniferous (see the *Canada Geological Survey Reports:* Ells, 1882-84, 1885 ; Fletcher, 1886,

1890–91). Their description of the rock-beds shows a good deal of resemblance to those of Newark. Fletcher, in his last report, gives several detailed sections of Permian rocks up to five thousand and eight thousand feet in thickness. It seems hardly probable that no traces of so vast a formation should be found in the eastern United States near either the Mesozoic or Paleozoic rocks with which it is so intimately associated in Nova Scotia and Prince Edward Island.

It would seem, then, that the Mesozoic age of the beds of Newark is not so thoroughly certain but that it might be worth while for paleontologists to reëxamine with renewed care the indications of the fossils that really bear on the point. For undoubtedly the very scanty and imperfect testimony of the fossils already known ; the apparent bias, on the one hand, in favor of comparing them only with Mesozoic forms that are extremely remote at best ; on the other hand, the less biased partial identification of some Newark fossils with Paleozoic ones under conditions at least equally favorable as regards skill and material ; the great thickness of measures below the comparatively well-identified Rhætic or Triassic horizon of the Gwynedd and Phœnixville shales, the same probably as the Richmond and North Carolina coal-bearing beds ; and the possibility, to say the least, that some of the red beds conformably at the top of the Carboniferous rocks of southwestern Pennsylvania and of West Virginia, as well as some of the Permian or Carboniferous beds of eastern Canada, may be of identical age with the Newark beds ; all these circumstances make it seem not altogether improbable that the Newark brownstone is older than the Mesozoic.

Further on the Age of the Newark Brownstone.

By Benjamin Smith Lyman.

(*Read before the American Philosophical Society, January 19, 1894.*)

An additional reason for doubting the Mesozoic age of the Newark brownstone may be found in the remarks of Newberry on his fossil plant *Dendrophycus triassicus*, found at Portland, Conn., in sandstone of possibly the same age as the Newark brownstone. He quotes (Monograph xiv, p. 82) Lesquereux's description of *Dendrophycus Desori*, found in the Pennsylvania No. XI, or Umbral shales ; and adds : "I have copied this description nearly entire because it is almost literally applicable to a plant represented on Pl. xxi of this memoir and obtained from the sandstones of Portland, Conn. When we consider the vast interval of time between the deposition of the Umbral shale of Pennsylvania and that of the Rhætic sandstone of Connecticut, one the base of the Carboniferous sys-

tem and the other the summit of the Trias, it cannot fail to be regarded as interesting and surprising that the resemblance should be so complete. But for the *a priori* improbability that a species of seaweed should be so long-lived I should hardly feel justified in giving even a new specific name to the Triassic specimens. Possibly a comparison of more material would show differences not now perceptible, but the peculiar mode of growth and the details of structure seem to be essentially the same. In the Portland sandstones, as in the Umbral shales, the fronds of Dendrophycus are enrolled in masses that suggest cabbage heads of large size and rather loose texture, while the mode of subdivision and the character of the final ramifications of the fronds are so like that, with the similarity of the enclosing rock, the specimens from the two localities and horizons are almost undistinguishable."

It seems clear that the Portland *Dendrophycus*, if viewed without prejudice, would, like the Belleville and Newark *Lepidodendron*, strongly indicate the Paleozoic age of the brownstone.

It is not yet certain, however, whether the Portland sandstone and the Newark brownstone are of the same age; for the Portland beds are near the eastern edge of the so called Mesozoic rocks of Connecticut that have generally easterly dips, so that the beds have sometimes been taken to be near the top of the column, while the Newark beds are no doubt towards the bottom of the so-called Mesozoic of New Jersey. Still the geological structure in Connecticut has not been so thoroughly worked out as to make that position of the Portland beds perfectly sure. Percival's map would seem rather to indicate that they are on the eastern side of a basin; and Dana (*Am. Jour. Sci.*, 1891, Vol. xlii, p. 446) says the sandstone at Portland is nearly horizontal, and occasionally the dip is westerly. It seems, then, not impossible that some of the lower, more ancient beds have here come to the surface. It is not yet known, either, how great may be the total thickness of the Connecticut Mesozoic, so-called; nor to what parts of the New Jersey and Pennsylvania rocks it may correspond. But the lithological character, as well as the decidedly Paleozoic look of the only determined fossil of the Portland beds, go somewhat strongly to show an identity in age with the Newark brownstone.

At any rate the paleontological argument for the Mesozoic age of all parts of the so-called New Red is plainly not so perfect as it has often been supposed to be.

Nagualism. A Study in Native American Folk-lore and History.

By Daniel G. Brinton, M.D.

(*Read before the American Philosophical Society, Jan'y 5, 1894.*)

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1. The words *Nagual, Nagualism, Nagualist.* 2. The Earliest Reference to Nagualism. 3. The *Naualli* of the Aztecs; their Classes and Pretended Powers. 4. The Sacred Intoxicants; the *Peyotl*, the *Ololiuhqui*, the *Teopatli*, the *Yax Ha*, etc. 5. Clairvoyance and Telepathy during Intoxication. 6. The *Naualli* of Modern Mexico. 7. The *Tonal* and the *Tonalpouhque;* the Genethliac System of the Nahuas. 8. The Aztec Sodality of "Master Magicians." 9. The Personal Guardian Spirit.

10. Folk-lore of the Mixe Indians. 11. Astrological Divination of the Zapotecs. 12. Similar Arts of the Mixtecs. 13. Nagualism in Chiapas, as Described by Bishop Nuñez de la Vega. 14. Nagualism Among the Quiches, Cakchiquels and Pokonchis of Guatemala. 15. The Metamorphoses of Gukumatz. 16. Modern Witchcraft in Yucatan and Central America; the Zahoris and Padrinos.

17. Fundamental Principles of Nagualism, Hatred of the Whites and of Christianity. 18. Its Organization and Extent; its Priesthood. 19. Its Influence in the Native Revolts against the Spanish Power. 20. Exalted Position of Woman in Nagualism. 21. This a Survival from Ancient Times. 22. A Native Joan of Arc. 23. Modern Queens of Nagualism.

24. The Cave-temples and the Cave-gods; Oztoteotl, Tepeyollotl, Votan, etc. 25. The Sacred Numbers, 3 and 7. 26. Fire Worship of the Nagualists. 27. Fire Rights Connected with the Pulque. 28. Fire Ceremonies of the Modern Mayas. 29. Secret Significance of Fire Worship. 30. The Chalchiuites, or Sacred Green Stones. 31. The Sacred Tree and the Tree of Life. 32. The Cross and its Symbolic Meaning. 33. The Lascivious Rites of the Nagualists. 34. Their Relation to the Symbols of the Serpent and the Phallus.

35. Confusion of Christian and Native Religious Ideas; Prayers of Nagual Priests. Their Symbolic Language. 36. The Inquisition and Nagualism. 37. Etymology of the Word *Nagual.* 38. The Root *Na* in the Maya, Zapotec and Nahuatl Languages. 39. The Doctrine of Animal Transformation in the Old World. 40. The Doctrine of Personal Spirits in the Old World. 41. Scientific Explanations of Nagual Magic. 42. Conclusion.

1. The words, a *nagual*, *nagualism*, a *nagualist*, have been current in English prose for more than seventy years; they are found during that time in a variety of books published in England and the United States,* yet are not to be discovered in any dictionary of the English language; nor has *Nagualism* a place in any of the numerous encyclopædias or "Conversation Lexicons," in English, French, German or Spanish.

This is not owing to its lack of importance, since for two hundred years past, as I shall show, it has been recognized as a cult, no less powerful than mysterious, which united many and diverse tribes of Mexico and Central America into organized opposition against the government and the religion which had been introduced from Europe; whose members had acquired and were bound together by strange faculties and an occult learning, which placed them on a par with the famed thaumaturgists and theodidacts of the Old World; and which preserved even into our own days the thoughts and forms of a long suppressed ritual.

In several previous publications I have referred briefly to this secret sodality and its aims,† and now believe it worth while to collect my scattered notes and present all that I have found of value about the origin, aims and significance of this Eleusinian Mystery of America. I shall trace its geographical extension and endeavor to discover what its secret influence really was and is.

2. The earliest description I find of its particular rites is that which the historian Herrera gives, as they prevailed in 1530, in the province of Cerquin, in the mountainous parts of Honduras. It is as follows:

"The Devil was accustomed to deceive these natives by appearing to them in the form of a lion, tiger, coyote, lizard, snake, bird, or other animal. To these appearances they apply the name *Naguales*, which is as much as to say, guardians or companions; and when such an animal dies, so does the Indian to whom it was assigned. The way such an alliance was formed was thus: The Indian repaired to some very retired spot

* These words occur a number of times in the English translation, published at London in 1822, of Dr. Paul Felix Cabrera's *Teatro Critico Americano*. The form *nagual* instead of *nahual*, or *naual*, or *nawal* has been generally adopted and should be preferred.

† For instance, in "The Names of the Gods in the Kiche Myths," pp. 21, 22, in *Proceedings of the American Philosophical Society*, 1881; *Annals of the Cakchiquels*, Introduction, p. 46; *Essays of an Americanist*, p. 170, etc.

and there appealed to the streams, rocks and trees around him, and weeping, implored for himself the favors they had conferred on his ancestors. He then sacrificed a dog or a fowl, and drew blood from his tongue, or his ears, or other parts of his body, and turned to sleep. Either in his dreams or half awake, he would see some one of those animals or birds above mentioned, who would say to him, 'On such a day go hunting and the first animal or bird you see will be my form, and I shall remain your companion and *Nagual* for all time.' Thus their friendship became so close that when one died so did the other; and without such a *Nagual* the natives believe no one can become rich or powerful."*

This province of Cerquin appears to have been peopled by a tribe which belonged to the great Mayan stock, akin to those which occupied most of the area of what is now Yucatan, Tabasco, Chiapas and Guatemala.† I shall say something later about the legendary enchantress whom their traditions recalled as the teacher of their ancestors and the founder of their nation. What I would now call attention to is the fact that in none of the dialects of the specifically Mexican or Aztecan stock of languages do we find the word *nagual* in the sense in which it is employed in the above extract, and this is strong evidence that the origin of Nagualism is not to be sought in that stock.

3. We do find, however, in the Nahuatl language, which is the proper name of the Aztecan, a number of derivatives from the same root, *na*, among them this very word, *Nahuatl*, all of them containing the idea "to know," or "knowledge." The early missionaries to New Spain often speak of the *naualli* (plural, *nanahualtin*), masters of mystic knowledge, dealers in the black art, wizards or sorcerers. They were not always evil-minded persons, though they seem to have been generally feared. The earliest source of information about them is Father Sahagun, who, in his invaluable History, has the following paragraph:

"The *naualli*, or magician, is he who frightens men and sucks the blood of children during the night. He is well-skilled in the practice of this trade, he knows all the arts of sorcery (*nauallotl*) and employs them with cunning and ability; but for the benefit of men only, not for their

* *Historia de las Indias Occidentales*, Dec. iv, Lib. viii, cap. 4.

† More especially it is the territory of the Chorti dialect, spoken to this day in the vicinity of the famous ancient city of Copan, Honduras. Cerquin lies in the mountains nearly due east of this celebrated site. On the Chorti, see Stoll, *Zur Ethnographie der Republik Guatemala*, pp. 106–9.

injury. Those who have recourse to such arts for evil intents injure the bodies of their victims, cause them to lose their reason and smother them. These are wicked men and necromancers."*

It is evident on examining the later works of the Roman clergy in Mexico that the Church did not look with any such lenient eye on the possibly harmless, or even beneficial, exercise of these magical devices. We find a further explanation of what they were, preserved in a work of instruction to confessors, published by Father Juan Bautista, at Mexico, in the year 1600.

"There are magicians who call themselves *teciuhtlazque*,† and also by the term *nanahualtin*, who conjure the clouds when there is danger of hail, so that the crops may not be injured. They can also make a stick look like a serpent, a mat like a centipede, a piece of stone like a scorpion, and similar deceptions. Others of these *nanahualtin* will transform themselves to all appearances (segun la aparencia), into a tiger, a dog or a weasel. Others again will take the form of an owl, a cock, or a weasel; and when one is preparing to seize them, they will appear now as a cock, now as an owl, and again as a weasel. These call themselves *nanahualtin*."‡

There is an evident attempt in this somewhat confused statement to distinguish between an actual transformation, and one which only appears such to the observer.

In another work of similar character, published at Mexico a few years later, the "Road to Heaven," of Father Nicolas de Leon, we find a series of questions which a confessor should put to any of his flock suspected of these necromantic practices. They reveal to us quite clearly what these occult practitioners were believed to do. The passage reads as follows, the questions being put in the mouth of the priest:

"Art thou a soothsayer? Dost thou foretell events by reading signs, or by interpreting dreams, or by water, making circles and figures on its surface? Dost thou sweep and ornament with flower garlands the places where idols are preserved? Dost thou know certain words with which to conjure for success in hunting, or to bring rain?

"Dost thou suck the blood of others, or dost thou wander about at night, calling upon the Demon to help thee? Hast thou drunk *peyotl*, or hast thou given it to others to drink, in order to find out secrets, or to discover where stolen or lost articles were? Dost thou know how to speak to vipers in such words that they obey thee?" §

* Bernardino de Sahagun, *Historia de la Nueva España*, Lib. x, cap. 9.

† Derived from *teciuhtiaza*, to conjure against hail, itself from *teciuh*, hail. Alonso de Molina, *Vocabulario Mexicano*, sub voce.

‡ Bautista *Advertencias para los Confesores*, fol. 112 (Mexico, 1600).

§ Nicolas de Leon, *Camino del Cielo*, fol. 111 (Mexico, 1611).

4. This interesting passage lets in considerable light on the claims and practices of the nagualists. Not the least important item is that of their use of the intoxicant, *peyotl*, a decoction of which it appears played a prominent part in their ceremonies. This is the native Nahuatl name of a certain plant, having a white, tuberous root, which is the part employed. It is mentioned as "pellote" or "peyote" in the *Farmacopea Mexicana* as a popular remedy, but its botanical name is not added. According to Paso y Troncoso, it is one of the Compositæ, a species of the genus *Cacalia*.* It is referred to in several passages by Father Sahagun, who says that it grows in southern Mexico, and that the Aztecs derived their knowledge of it from the older "Chichimecs." It was used as an intoxicant.

"Those who eat or drink of this *peyotl* see visions, which are sometimes frightful and sometimes ludicrous. The intoxication it causes lasts several days. The Chichimecs believed that it gave them courage in time of danger and diminished the pangs of hunger and thirst."†

Its use was continued until a late date, and very probably has not yet died out. Its composition and method of preparation are given in a list of beverages prohibited by the Spanish authorities in the year 1784, as follows:

"*Peyote:* Made from a species of vinagrilla, about the size of a billiard ball, which grows in dry and sterile soil. The natives chew it, and throw it into a wooden mortar, where it is left to ferment, some leaves of tobacco being added to give it pungency. They consume it in this form, sometimes with slices of *peyote* itself, in their most solemn festivities, although it dulls the intellect and induces gloomy and hurtful visions (sombras muy funestas)."‡

The *peyotl* was not the only herb prized as a means of casting the soul into the condition of hypostatic union with divinity. We have abundant evidence that long after the conquest the seeds of the plant called in Nahuatl the *ololiuhqui* were in high

* Paso y Troncoso, in *Anales del Museo Nacional de Mexico*, Tom. iii, p. 180.

† Sahagun, *Historia de Nueva España*, Lib. x, cap. 29, and Lib. xi, cap. 7. Hernandez has the following on the mysterious properties of this plant: "Illud ferunt de hac radice mirabile (si modo fides sit vulgatissimæ inter eos rei habendæ), devorantes illam quodlibet præsagire prædicereque; velut an sequenti die hostes sint impetum in eos facturi? Anne illos felicia maneant tempora? Quis supellectilem, aut aliud quidpiam furto subripruerit? Et ad hunc modum alia, quibus Chichimecæ hujusmodi medicamine cognoscendis." Franciscus Hernandus, *Historia Plantarum Novæ Hispaniæ*, Tom. iii, p. 71 (Ed., Madrid, 1790).

‡ *Diccionario Universal*, Appendice, Tom. i, p. 360 (Mexico, 1856).

esteem for this purpose. In the Confessionary of Father Bartholomé de Alva the priest is supposed to inquire and learn as follows:

"*Question.* Hast thou loved God above all things? Hast thou loved any created thing, adoring it, looking upon it as God, and worshiping it?

"*Answer.* I have loved God with all my heart; but sometimes I have believed in dreams, and also I have believed in the sacred herbs, the *peyotl*, and the *ololiuhqui*; and in other such things (*onicneltocac in temictli, in xiuhtzintli, in peyotl, in ololiuhqui, yhuan in occequitlamantli*)."*

The seeds of the *ololiuhqui* appear to have been employed externally. They were the efficient element in the mysterious unguent known as "the divine remedy" (*teopatli*), about which we find some information in the works of Father Augustin de Vetancurt, who lived in Mexico in the middle of the seventeenth century. He writes:

"The pagan priests made use of an ointment composed of insects, such as spiders, scorpions, centipedes and the like, which the neophytes in the temples prepared. They burned these insects in a basin, collected the ashes, and rubbed it up with green tobacco leaves, living worms and insects, and the powdered seeds of a plant called *ololiuhqui*, which has the power of inducing visions, and the effect of which is to destroy the reasoning powers. Under the influence of this ointment, they conversed with the Devil, and he with them, practicing his deceptions upon them. They also believed that it protected them, so they had no fear of going into the woods at night.

"This was also employed by them as a remedy in various diseases, and the soothing influence of the tobacco and the *ololiuhqui* was attributed by them to divine agency. There are some in our own day who make use of this ointment for sorcery, shutting themselves up, and losing their reason under its influence; especially some old men and old women, who are prepared to fall an easy prey to the Devil."†

The botanist Hernandez observes that another name for this plant was *coaxihuitl*, "serpent plant," and adds that its seeds contain a narcotic poison, and that it is allied to the genus *Solanum*, of which the deadly night-shade is a familiar species. He speaks of its use in the sacred rites in these words:

"Indorum sacrifici, cum videri volebant versari cum superis, ac responsa accipere ab eis, ea vescebantur planta, ut desiperent, milleque phantasmata et demonum observatium effigies circumspectarent."‡

* *Confessionario Mayor y Menor en lengua Mexicana*, fol. 8, verso (Mexico, 1634).

† Vetancurt, *Teatro Mexicano*, Trat. iii, cap. 9.

‡ Hernandez, *Historia Plantarum Novæ Hispaniæ*, Tom. iii, p. 32.

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Of the two plants mentioned, the *ololiuhqui* and the *peyotl*, the former was considered the more potent in spiritual virtues. "They hold it in as much veneration as if it were God," says a theologian of the seventeenth century.* One who partook of these herbs was called *payni* (from the verb *pay*, to take medicine); and more especially *tlachixqui*, a Seer, referring to the mystic "second sight," hence a diviner or prophet (from the verb *tlachia*, to see).

Tobacco also held a prominent, though less important, place in these rites. It was employed in two forms, the one the dried leaf, *picietl*, which for sacred uses must be broken and rubbed up either seven or nine times; and the green leaf mixed with lime, hence called *tenextlecietl* (from *tenextli*, lime).

Allied in effect to these is an intoxicant in use in southern Mexico and Yucatan, prepared from the bark of a tree called by the Mayas *baal-che*. The whites speak of the drink as *pitarilla*. It is quite popular among the natives, and they still attribute to it a sacred character, calling it *yax ha*, the first water, the primal fluid. They say that it was the first liquid created by God, and when He returned to His heavenly home He left this beverage and its production in charge of the gods of the rains, the four Pah-Ahtuns.†

5. Intoxication of some kind was an essential part of many of these secret rites. It was regarded as a method of throwing the individual out of himself and into relation with the supernal powers. What the old historian, Father Joseph de Acosta, tells us about the clairvoyants and telepaths of the aborigines might well stand for a description of their modern representatives:

"Some of these sorcerers take any shape they choose, and fly through the air with wonderful rapidity and for long distances. They will tell what is taking place in remote localities long before the news could possibly arrive. The Spaniards have known them to report mutinies, battles, revolts and deaths, occurring two hundred or three hundred leagues distant, on the very day they took place, or the day after.

* Dr. Jacinto de la Serna, *Manual de Ministros de Indios para el Conocimiento de sus Idolatrias y Extirpacion de Ellas*, p. 163. This interesting work was composed about the middle of the seventeenth century by a Rector of the University of Mexico, but was first printed at Madrid, in 1892, from the MS. furnished by Dr. N. Leon, under the editorship of the Marquis de la Fuensanta del Valle.

† MSS. of the Licentiate Zetina, and *Informe* of Father Baeza in *Registro Yucateco*, Tom. I.

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"To practice this art the sorcerers, usually old women, shut themselves in a house, and intoxicate themselves to the degree of losing their reason. The next day they are ready to reply to questions."*

Plants possessing similar powers to excite vivid visions and distort the imagination, and, therefore, employed in the magical rites, were the *thiuimeezque*, in Michoacan, and the *chacuaco*, in lower California.†

6. In spite of all effort, the various classes of wonder-workers continued to thrive in Mexico. We find in a book of sermons published by the Jesuit Father, Ignacio de Paredes, in the Nahuatl language, in 1757, that he strenuously warns his hearers against invoking, consulting, or calling upon "the devilish spell-binders, the nagualists, and those who conjure with smoke."‡

They have not yet lost their power; we have evidence enough that many children of a larger growth in that land still listen with respect to the recitals of the mysterious faculties attributed to the *nanahualtin*. An observant German traveler, Carlos von Gagern, informs us that they are widely believed to be able to cause sicknesses and other ills, which must be counteracted by appropriate exorcisms, among which the reading aloud certain passages of the Bible is deemed to be one of the most potent.§

The learned historian, Orozco y Berra, speaks of the powers attributed at the present day to the *nahual* in Mexico among the lower classes, in these words:

"The *nahual* is generally an old Indian with red eyes, who knows how to turn himself into a dog, woolly, black and ugly. The female witch can convert herself into a ball of fire; she has the power of flight, and at night will enter the windows and suck the blood of little children. These sorcerers will make little images of rags or of clay, then stick into them the thorn of the maguey and place them in some secret place; you can

* Acosta, *De la Historia Moral de Indias*, Lib. v, cap. 26.

† Of the *thiuimeezque* Hernandez writes: "Aiunt radicis cortice unius unciæ pondere tuso, atque devorato, multa ante oculos observare phantasmata, multiplices imagines ac monstrificas rerum figuras, detegique furem, si quidpiam rei familiaris subreptum sit." *Hist. Plant. Nov. Hispan.*, Tom. iii, p. 272. The *chacuaco* and its effects are described by Father Venegas in his *History of California*, etc.

‡ "In Mictlan Tetlachihuique, in Nanahualtin, in Tlahuipuchtin." Paredes, *Promptuario Manual Mexicano*, p. 128 (Mexico, 1757). The *tlahuipuchtin*, "those who work with smoke," were probably diviners who foretold the future from the forms taken by smoke in rising in the air. This class of augurs were also found in Peru, where they were called *Uirapircos* (Balboa, *Hist. du Perou*, p. 28-30).

§ Von Gagern, *Charakteristik der Indianischer Bevölkerung Mexikos*, s. 125.

be sure that the person against whom the conjuration is practiced will feel pain in the part where the thorn is inserted. There still exist among them the medicine-men, who treat the sick by means of strange contortions, call upon the spirits, pronounce magical incantations, blow upon the part where the pain is, and draw forth from the patient thorns, worms, or pieces of stone. They know how to prepare drinks which will bring on sickness, and if the patients are cured by others the convalescents are particular to throw something of their own away, as a lock of hair, or a part of their clothing. Those who possess the evil eye can, by merely looking at children, deprive them of beauty and health, and even cause their death."*

7. As I have said, nowhere in the records of purely Mexican, that is, Aztecan, Nagualism do we find the word *nagual* employed in the sense given in the passage quoted from Herrera, that is as a personal guardian spirit or tutelary genius. These tribes had, indeed, a belief in some such protecting power, and held that it was connected with the day on which each person is born. They called it the *tonalli* of a person, a word translated to mean that which is peculiar to him, which makes his individuality, his self. The radical from which it is derived is *tona*, to warm, or to be warm, from which are also derived *tonatiuh*, the sun. *Tonalli*, which in composition loses its last syllable, is likewise the word for heat, summer, soul, spirit and day, and also for the share or portion which belongs to one. Thus, *to-tonal* is spirit or soul in general; *no-tonal*, my spirit; *no-tonal in ipan no-tlacat*, "the sign under which I was born," *i. e.*, the astrological day-sign. From this came the verb *tonalpoa*, to count or estimate the signs, that is, to cast the horoscope of a person; and *tonalpouhque*, the diviners whose business it was to practice this art.†

These *tonalpouhque* are referred to at length by Father Sahagun.‡ He distinguishes them from the *naualli*, though it is clear that they corresponded in functions to the nagualistic priests of the southern tribes. From the number and name of the day of

* *Historia Antigua de Mexico*, Tom. ii, p. 25. Francisco Pimentel, in his thoughtful work, *Memoria sobre las Causas que han originado la Situacion Actual de la Raza Indigena de Mexico* (Mexico, 1864), recognizes how almost impossible it is to extirpate their faith in this nagualism. "Conservan los agueros y supersticiones de la antigüedad, siendo cosa de fe para ellos, los *nahuales*," etc., p. 200, and comp. p. 145.

† On these terms consult the extensive *Dictionnaire de la Langue Nahuatl*, by Rémi Simeon, published at Paris, 1887. It is not impossible that *tona* is itself a compound root, including the monosyllabic radical *na*, which is at the basis of *nagual*.

‡ Sahagun, *Historia de Nueva España*, Lib. iv, *passim*, and Lib. x, cap. 9.

birth they forecast the destiny of the child, and stated the power or spiritual influence which should govern its career.

The *tonal* was by no means an indefeasible possession. It was a sort of independent *mascotte*. So long as it remained with a person he enjoyed health and prosperity; but it could depart, go astray, become lost; and then sickness and misfortune arrived. This is signified in the Nahuatl language by the verbs *tonalcaualtia*, to check, stop or suspend the *tonal*, hence, to shock or frighten one; and *tonalitlacoa*, to hurt or injure the *tonal*, hence, to cast a spell on one, to bewitch him.

This explains the real purpose of the conjuring and incantations which were carried on by the native doctor when visiting the sick. It was to recall the *tonal*, to force or persuade it to return; and, therefore, the ceremony bore the name "the restitution of the *tonal*," and was more than any other deeply imbued with the superstitions of Nagualism. The chief officiant was called the *tetonaltiani*, "he who concerns himself with the tonal." On a later page I shall give the formula recited on such an occasion.

8. There is some vague mention in the Aztec records of a semi-priestly order, who bore the name *naualteteuctin*, which may be translated "master magicians." They were also known as *teotlauice*, "sacred companions in arms." As was the case with most classes of the *teteuctin*, or nobles, entrance to the order was by a severe and prolonged ceremony of initiation, the object of which was not merely to test the endurance of pain and the powers of self-denial, but especially to throw the mind into that subjective state in which it is brought into contact with the divine, in which it can "see visions and dream dreams." The order claimed as its patron and founder Quetzalcoatl, the "feathered serpent," who, it will be seen on another page, was also the patron of the later nagualists.*

The word *naualli* also occurs among the ancient Nahuas in composition as a part of proper names; always with the signification of "magician," as in that of Naualcuauhtla, a chief of the Chalcos, meaning "wizard-stick," referring probably to the

* See Ch. de Labarthe, *Révue Américaine*, Serie ii, Tom. ii, pp. 222-225. His translation of *naualteteuctin* by "Seigneurs du génie" must be rejected, as there is absolutely no authority for assigning this meaning to *naualli*.

rod or wand employed by the magi in conjuration.* So also *Naualac*, the "wizard water," an artificial lake not far from the city of Mexico, surrounded by ruined temples, described by M. Charnay.†

9. The belief in a personal guardian spirit was one of the fundamental doctrines of Nagualism; but this belief by no means connotes the full import of the term (as Mr. H. H. Bancroft has erroneously stated). The calendar system of Mexico and Central America, which I have shown to be substantially the same throughout many diverse linguistic stocks,‡ had as one of its main objects, astrological divination. By consulting it the appropriate nagual was discovered and assigned, and this was certainly a prominent feature in the native cult and has never been abandoned.

In Mexico to-day, in addition to his special personal guardian, the native will often choose another for a limited time or for a particular purpose, and this is quite consistent with the form of Christianity he has been taught. For instance, as we are informed by an observant traveler, at New Year or at corn-planting the head of a family will go to the parish church and among the various saints there displayed will select one as his guardian for the year. He will address to him his prayers for rain and sunshine, for an abundant harvest, health and prosperity, and will not neglect to back these supplications by liberal gifts. If times are good and harvests ample the Santo is rewarded with still more gifts, and his aid is sought for another term; but if luck has been bad the Indian repairs to the church at the end of the year, bestows on his holy patron a sound cursing, calls him all the bad names he can think of, and has nothing more to do with him.§

10. A Mexican writer, Andres Iglesias, who enjoyed more than common opportunities to study these practices as they exist in the present generation, describes them as he saw them in the village of Soteapan, a remote hamlet in the State of Vera Cruz, the population of which speak the Mixe language. This

* *Anales de Cuauhtitlan*, p. 31. The translator renders it "palo brujo."

† *Les Anciennes Villes du Nouveau Monde*, pp. 146–148, figured on p. 150. On its significance compare Hamy, *Decades Americanæ*, pp. 74–81.

‡ *The Native Calendar of Central America and Mexico* (Philadelphia, 1893).

§ Eduard Mühlenpfordt, *Mexico*, Bd. I, s. 255.

is not related to the Nahuatl tongue, but the terms of their magical rites are drawn from Nahuatl words, showing their origin. Every person at birth has assigned to him both a good and a bad genius, the former aiming at his welfare, the latter at his injury. The good genius is known by the Nahuatl term *tonale*, and it is represented in the first bird or animal of any kind which is seen in or near the house immediately after the birth of the infant.

The most powerful person in the village is the high priest of the native cult. One who died about 1850 was called "the Thunderbolt," and whenever he walked abroad he was preceded by a group of chosen disciples, called by the Nahuatl name *tlatoques*, speakers or attorneys.* His successor, known as "the Greater Thunder," did not maintain this state, but nevertheless claimed to be able to control the seasons and to send or to mitigate destructive storms—claims which, sad to say, brought him to the stocks, but did not interfere with the regular payment of tribute to him by the villagers. He was also a medicine man and master of ceremonies in certain "scandalous orgies, where immodesty shows herself without a veil."

11. Turning to the neighboring province of Oaxaca and its inhabitants, we are instructed on the astrological use of the calendar of the Zapotecs by Father Juan de Cordova, whose *Arte* of their language was published at Mexico in 1578. From what he says its principal, if not its only purpose, was astrological. Each day had its number and was called after some animal, as eagle, snake, deer, rabbit, etc. Every child, male or female, received the name of the day, and also its number, as a surname; its personal name being taken from a fixed series, which differed in the masculine and feminine gender, and which seems to have been derived from the names of the fingers.

From this it appears that among the Zapotecs the personal spirit or *nagual* was fixed by the date of the birth, and not by some

* The word is derived from *tlatoa*, to speak for another, and its usual translation was "chief," as the head man spoke for, and in the name of the gens or tribe.

† The interesting account by Iglesias is printed in the Appendix to the *Diccionario Universal de Geographia y Historia* (Mexico, 1856). Other writers testify to the tenacity with which the Mixes cling to their ancient beliefs. Señor Moro says they continue to be "notorious idolaters," and their actual religion to be "an absurd jumble of their old superstitions with Christian doctrines" (in Orozco y Berra, *Geografía de las Lenguas de Mexico*, p. 176).

later ceremony, although the latter has been asserted by some writers; who, however, seem to have applied without certain knowledge the rites of the Nahuas and other surrounding tribes to the Zapotecs.*

Next in importance to the assigning of names, according to Father Cordova, was the employment of the calendar in deciding the propriety of marriages. As the recognized object of marriage was to have sons, the couple appealed to the professional augur to decide this question before the marriage was fixed. He selected as many beans as was the sum of the numbers of the two proponents' names, and, counting them by twos, if one remained over, it meant a son; then counting by threes any remainder also meant sons; by fours the remainder meant either sons or daughters; and by five and six the same; and if there was no remainder by any of these five divisors the marriage would result in no sons and was prohibited.

It is obvious that this method of fortune-telling was most auspicious for the lovers; for I doubt if there is any combination of two numbers below fourteen which is divisible by two, three, four, five and six without remainder in any one instance.†

The Zapotecs were one of those nations who voluntarily submitted themselves to the Spaniards, not out of love for the Europeans, but through hatred of the Aztecs, who had conquered them in the preceding century. Their king, Coyopy, and his subjects accepted Christianity. and were generally baptized; but it was the merest formality, and years afterwards Coyopy was detected secretly conducting the heathen ritual of his ancestors with all due pomp. He was arrested, sent to the city of Mexico, deprived of his power and wealth, and soon died; it is charitably supposed, from natural causes. There is no question but that he left successors to the office of pontifex maximus, and that they continued the native religious ceremonies.

12. The sparse notices we have of the astrology of the Mixtecs, neighbors and some think relatives of the Zapotecs, reveal

* For instance, J. B. Carriedo, in his *Estudios Historicos del Estado Oaxaqueño* (Oaxaca, 1849), p. 15, says the *nahualt* was a ceremony performed by the native priest, in which the infant was bled from a vein behind the ear, assigned a name, that of a certain day, and a guardian angel or *tona*. These words are pure Nahuatl, and Carriedo, who does not give his authority, probably had none which referred these rites to the Zapotecs.

† Juan de Cordova, *Arte en Lengua Zapoteca*, pp. 16, 202, 203, 213, 216.

closely similar rites. The name of their king, who opposed Montezuma the First some sixty years before the arrival of Cortez, proves that they made use of the same or a similar calendar in bestowing personal appellations. It is given as *Tres Micos*, Three Monkeys.

Unfortunately, so far as I know, there has not been published, and perhaps there does not exist, an authentic copy of the Mixtec calendar. It was nevertheless reduced to writing in the native tongue after the conquest, and a copy of it was seen by the historian Burgoa in the Mixtec town of Yanhuitlan.* Each day was named from a tree, a plant or an animal, and from them the individual received his names, as Four Lions, Five Roses, etc. (examples given by Herrera). This latter writer adds that the name was assigned by the priests when the child was seven years old (as among the Tzentals), part of the rite being to conduct it to the temple and bore its ears. He refers also to their auguries relating to marriage.† These appear to have been different from among the Zapotecs. It was necessary that the youth should have a name bearing a higher number than that of the maiden, and also "that they should be related;" probably this applied only to certain formal marriages of the rulers which were obliged to be within the same *gens*.

13. I have referred in some detail to the rites and superstitions connected with the Calendar because they are all essential parts of Nagualism, carried on far into Christian times by the priests of this secret cult, as was fully recognized by the Catholic clergy. Wherever this calendar was in use, the Freemasonry of Nagualism extended, and its ritual had constant reference to it. Our fullest information about it does not come from central Mexico, but further south, in the region occupied by the various branches of the Mayan stock, by the ancestors of some one of which, perhaps, this singular calendar, and the symbolism connected with it, were invented.

One of the most important older authorities on this subject is Francisco Nuñez de la Vega, a learned Dominican, who was appointed Bishop of Chiapas and Soconusco in 1687, and who published at Rome, in 1702, a stately folio entitled "*Constitu-*

* Quoted in Carriedo, ubi supra, p. 17.

† *Hist. de las Indias Oc.*, Dec. iii, Lib. iii, cap. 12.

ciones Diœcesanas del Obispado de Chiappa," comprising discussions of the articles of religion and a series of pastoral letters. The subject of Nagualism is referred to in many passages, and the ninth Pastoral Letter is devoted to it. As this book is one of extreme rarity, I shall make rather lengthy extracts from it, taking the liberty of condensing the scholastic prolixity of the author, and omitting his professional admonitions to the wicked.

He begins his references to it in several passages of his Introduction or *Preambulo*, in which he makes some interesting statements as to the use to which the natives put their newly-acquired knowledge of writing, while at the same time they had evidently not forgotten the ancient method of recording ideas invented by their ancestors.

The Bishop writes:

"The Indians of New Spain retain all the errors of their time of heathenism preserved in certain writings in their own languages, explaining by abbreviated characters and by figures painted in a secret cypher * the places, provinces and names of their early rulers, the animals, stars and elements which they worshiped, the ceremonies and sacrifices which they observed, and the years, months and days by which they predicted the fortunes of children at birth, and assign them that which they call the Naguals. These writings are known as Repertories or Calendars, and they are also used to discover articles lost or stolen, and to effect cures of diseases. Some have a wheel painted in them, like that of Pythagoras, described by the Venerable Bede; others portray a lake surrounded by the Naguals in the form of various animals. Some of the Nagualist Masters claim as their patron and ruler Cuchulchan, and they possessed a certain formula of prayer to him, written in the Popoluca tongue (which was called Baha in their time of heathenism), and which has been translated into Mexican.†

"Those who are selected to become the masters of these arts are taught from early childhood how to draw and paint these characters, and are obliged to learn by heart the formulas, and the names of the ancient Nagualists, and whatever else is included in these written documents, many of which we have held in our hands, and have heard them explained by such masters whom we had imprisoned for their guilt, and who had afterwards become converted and acknowledged their sins."‡

* So I understand the phrase, "figuras pintadas con zifras enigmaticas."

† *Popoluca* was a term applied to various languages. I suspect the one here referred to was the Mixe. See an article by me, entitled "Chontales and Popolucas; a Study in Mexican Ethnography," in the *Compte Rendu* of the Eighth Session of the Congress of Americanists, p. 556, *seq.*

‡ *Constit. Diocesan*, p. 19.

The Bishop made up his mind that extreme measures should be taken to eradicate these survivals of the ancient paganism in his diocese, and he therefore promulgated the following order in the year 1692:

"And because in the provinces of our diocese those Indians who are Nagualists adore their *naguals*, and look upon them as gods, and by their aid believe that they can foretell the future, discover hidden treasures, and fulfill their dishonest desires: we, therefore, prescribe and command that in every town an ecclesiastical prison shall be constructed at the expense of the church, and that it be provided with fetters and stocks (con grillos y cepos), and we confer authority on every priest and curate of a parish to imprison in these gaols whoever is guilty of disrespect toward our Holy Faith, and we enjoin them to treat with especial severity those who teach the doctrines of Nagualism (y con rigor mayor á los dogmatizantes Nagualistas)." *

In spite of these injunctions it is evident that he failed to destroy the seeds of what he esteemed this dangerous heresy in the parishes of his diocese; for his ninth Pastoral Letter, in which he exposes at length the character of Nagualism, is dated from the metropolitan city of Ciudad Real, on May 24, 1698. As much of it is germane to my theme, I translate as follows:

"There are certain bad Christians of both sexes who do not hesitate to follow the school of the Devil, and to occupy themselves with evil arts, divinations, sorceries, conjuring, enchantments, fortune-telling, and other means to forecast the future.

"These are those who in all the provinces of New Spain are known by the name of *Nagualists*. They pretend that the birth of men is regulated by the course and movements of stars and planets, and by observing the time of day and the months in which a child is born, they prognosticate its condition and the events, prosperous or otherwise, of its life; and the worst is that these perverse men have written down their signs and rules, and thus deceive the erring and ignorant.

"These Nagualists practice their arts by means of Repertories and superstitious Calendars, where are represented under their proper names all the Naguals of stars, elements, birds, fishes, brute beasts and dumb animals; with a vain note of days and months, so that they can announce which corresponds to the day of birth of the infant. This is preceded by some diabolical ceremonies, after which they designate the field or other spot, where, after seven years shall have elapsed, the Nagual will appear to ratify the bargain. As the time approaches, they instruct the child to

* *Constitut. Diocesan*, Titulo vii, pp. 47, 48.

deny God and His Blessed Mother, and warn him to have no fear, and not to make the sign of the cross. He is told to embrace his Nagual tenderly, which, by some diabolical art, presents itself in an affectionate manner even though it be a ferocious beast, like a lion or a tiger. Thus, with infernal cunning they persuade him that this Nagual is an angel of God, who will look after him and protect him in his after life.

"To such diabolical masters the intelligent Indians apply, to learn from these superstitious Calendars, dictated by the Devil, their own fortunes, and the Naguals which will be assigned to their children, even before they are baptized. In most of the Calendars, the seventh sign is the figure of a man and a snake, which they call Cuchulchan. The masters have explained it as a snake with feathers which moves in the water. This sign corresponds with Mexzichuaut, which means Cloudy Serpent, or, of the clouds.* The people also consult them in order to work injury on their enemies, taking the lives of many through such devilish artifices, and committing unspeakable atrocities.

"Worse even than these are those who wander about as physicians or healers; who are none such, but magicians, enchanters, and sorcerers, who, while pretending to cure, kill whom they will. They apply their medicines by blowing on the patient, and by the use of infernal words; learned by heart by those who cannot read or write; and received in writing from their masters by those acquainted with letters. The Master never imparts this instruction to a single disciple, but always to three at a time, so that in the practice of the art it may be difficult to decide which one exerts the magical power. They blow on feathers, or sticks, or plants, and place them in the paths where they may be stepped on by those they wish to injure, thus causing chills, fevers, ugly pustules and other diseases; or they introduce into the body by such arts toads, frogs, snakes, centipedes, etc, causing great torments. And by these same breathings and magic words they can burn down houses, destroy the growing crops and induce sickness. No one of the three disciples is permitted to practice any of these arts without previously informing the other two, and also the Master, by whom the three have been taught.

"We have learned by the confession of certain guilty parties how the Master begins to instruct his disciple. First he tells him to abjure God, the saints and the Virgin, not to invoke their names, and to have no fear of them. He then conducts him to the wood, glen, cave or field where the pact with the Devil is concluded, which they call 'the agreement' or 'the word given' (in Tzental *quiz*). In some provinces the disciple is laid on an ant-hill, and the Master standing above him calls forth a snake, colored with black, white and red, which is known as 'the ant-mother' (in Tzental *zmezquiz*).† This comes accompanied by the ants

* Rather with the Quetzalcoatl of the Nahuas, and the Gucumatz of the Quiches, both of which names mean "Feathered Serpent." Mixcohuatl, the Cloud Serpent, in Mexican mythology, referred to the Thunder-storm.

† In his Tzental Vocabulary, Father Lara does not give this exact form; but in the neighboring dialect of the Cakchiquel Father Ximenes has *quikeho*, to agree together, to enter into an arrangement; the prefix *zme* is the Tzental word for "mother."

and other small snakes of the same kind, which enter at the joints of the fingers, beginning with the left hand, and coming out at the joints of the right hand, and also by the ears and the nose; while the great snake enters the body with a leap and emerges at its posterior vent. Afterwards the disciple meets a dragon vomiting fire, which swallows him entire and ejects him posteriorly. Then the Master declares he may be admitted, and asks him to select the herbs with which he will conjure; the disciple names them, the Master gathers them and delivers them to him, and then teaches him the sacred words.

"These words and ceremonies are substantially the same in all the provinces. The healer enters the house of the invalid, asks about the sickness, lays his hand on the suffering part, and then leaves, promising to return on the day following. At the next visit he brings with him some herbs which he chews or mashes with a little water and applies to the part. Then he repeats the *Pater Noster*, the *Ave*, the *Credo* and the *Salve*, and blows upon the seat of disease, afterwards pronouncing the magical words taught him by his master. He continues blowing in this manner, inhaling and exhaling, repeating under his breath these magical expressions, which are powerful to kill or to cure as he chooses, through the compact he has made with the Devil. Finally, so as to deceive the bystanders, he ends with saying in a loud voice: 'God the Father, God the Son, and God the Holy Ghost. Amen.'

"This physician or healer is called in the towns of some of the provinces *poxta vanegs*, and the medicine *gspoxil;* and everything relating to healing among the Indians to which they apply these terms means also to practice sorcery; and all words derived from *pox* allude to the Nagual; for this in some provinces is called *poxlon*, and in others *patzlan*, and in many *tzihuizin*, which is something very much feared by the Indians. We have ascertained by the confessions of many who have been reconciled that the Devil at times appears to them in the shape of a ball or globe of fire in the air, with a tail like a comet.*

"According to the most ancient traditions of these Indians this idol, *poxlon*, was one of the most important and venerated they had in the old

* Father Lara, in his *Vocabulario Tzendal MS.* (in my possession), gives for medical (medico), *ghpoxil;* for medicine (medicinal cosa), *pox, xpoxtacoghbil;* for physician (medico), *ghpoxta vinic* (the form *vanegh*, person, is also correct). The Tzendal *pox* (pronounced *pōsh*) is another form of the Quiche-Cakchiquel *pūz*, a word which Father Ximenes, in his *Vocabulario Cakchiquel* MS. (in my possession), gives in the compound *puz-naual*, with the meaning, enchanter, wizard. Both these, I take it, are derived from the Maya *puz*, which means to blow the dust, etc., off of something (soplar el polvo de la ropa ó otra cosa. *Dicc. de la Lengua Maya del Convento de Motul*, MS. The dictionary edited by Pio Perez does not give this meaning). The act of blowing was the essential feature in the treatment of these medicine men. It symbolized the transfer and exercise of spiritual power. When Votan built his underground shrine he did it *à soplos*, by blowing (Nuñez de la Vega, *Constitut. Diocesan*, p. 10). The natives did not regard the comet's tail as behind it but in front of it, blown from its mouth. The Nahuatl word in the text, *tzihuizin*, is the Pipil form of *xihuitzin*, the reverential of *xihuitl*, which means a leaf, a season, a year, or a comet. Apparently it refers to the Nahuatl divinity *Xiuhtécutli*, described by Sahagun, *Historia de Nueva España*, Lib. i, cap. 13, as god of fire, etc.

times, and the Tzentals revered it so much that they preserved it innumerable years painted on a tablet in the above figure. Even after they were converted to the faith, they hung it behind a beam in the church of the town of Oxchuc, accompanied by an image of their god Hicalahau, having a ferocious black face with the members of a man,* along with five owls and vultures. By divine interposition, we discovered these on our second visit there in 1687, and had no little difficulty in getting them down, we reciting the creed, and the Indians constantly spitting as they executed our orders. These objects were publicly burned in the plaza.

"In other parts they reverence the bones of the earlier Nagualists, preserving them in caves, where they adorn them with flowers and burn copal before them. We have discovered some of these and burned them, hoping to root out and put a stop to such evil ceremonies of the infernal sect of the Nagualists.

"At present, all are not so subject to the promptings of the Devil as formerly, but there are still some so closely allied to him that they transform themselves into tigers, lions, bulls, flashes of light and globes of fire. We can say from the declaration and solemn confession of some penitents that it is proved that the Devil had carnal relations with them, both as incubus and succubus, approaching them in the form of their Nagual; and there was one woman who remained in the forest a week with the demon in the form of her Nagual, acting toward him as does an infatuated woman toward her lover (como pudiera con su proprio amigo una muger amancebada). As a punishment for such horrible crimes our Lord has permitted that they lose their life as soon as their Nagual is killed; and that they bear on their own bodies the wound or mark of the blow which killed it; as the curas of Chamula, Copainala and other places have assured us.

"The devilish seed of this Nagualism has rooted itself in the very flesh and blood of these Indians. It perseveres in their hearts through the instructions of the masters of the sect, and there is scarcely a town in these provinces in which it has not been introduced. It is a superstitious idolatry, full of mónstrous incests, sodomies and detestable bestialities."

Such are the words of the Bishop of Chiapas. We learn from his thoroughly instructed and unimpeachable testimony that at the beginning of the eighteenth century Nagualism was a widespread and active institution among the Indians of southern Mexico; that it was taught and practiced by professors who were so much feared and respected that, as he tells us in another passage, they were called "masters of the towns;"† that they gave systematic instruction to disciples in classes of

* *Hicalahau*, for *ical ahau*, Black King, one of the Tzental divinities, who will be referred to on a later page.

† "Mæstros de los pueblos," *Constitut. Diocesan*, i, p. 106.

three, all of whom were bound together by pledges of mutual information and assistance; that a fundamental principle of the organization and an indispensable step in the initiation into its mysteries was the abjuration of the Christian religion, and an undying hatred to its teachers and all others of the race of the white oppressors; and that when they made use of Christian phrases or ceremonies it was either in derision or out of hypocrisy, the better to conceal their real sentiments.

There are a number of other witnesses from the seventeenth century that may be summoned to strengthen this testimony, if it needs it.

14. In the *History of Guatemala*, written about 1690 by Francisco Antonio Fuentes y Guzman, the author gives some information about a sorcerer of this school, who was arrested in Totonicapan, and with whom the historian had something to do as *corregidor*.

The redoubtable magician was a little old man, *viejezuelo*, and when caught had in his possession a document giving the days of the year according to the European calendar, with the Nagual, which belonged to each one. That for January is alone given by our writer, but it is probable that the other months merely repeated the naguals corresponding to the numbers. It ran as follows:

Nagual Calendar for January.

1. Lion.
2. Snake.
3. Stone.
4. Alligator.
5. Ceiba tree.
6. The quetzal (a bird).
7. A stick.
8. Rabbit.
9. A rope.
10. Leaf.
11. Deer.
12. Guacamayo (parrot).
13. Flower.
14. Toad.
15. Caterpillar.
16. A chip.
17. Arrow.
18. Broom.
19. Jaguar.
20. Corn-husk.
21. A flute.
22. Green-stone.
23. Crow.
24. Fire.
25. A pheasant.
26. A reed.
27. Opossum.
28. Huracan (the thunder-storm).
29. The vulture.
30. Hawk.
31. Bat.

When the sorcerer was examined as to the manner of assigning the proper nagual to a child he gave the following account:

Having been informed of its day of birth, he in due time called at the residence of the parents, and told the mother to bring the child into the field behind the house. Having there invoked the demon, the *nagual* of the child would appear under the form of the animal or object set opposite its birthday in the calendar, a serpent were it born on the 2d of January, a flower were it on the 13th, fire were it on the 24th, and so on. The sorcerer then addressed certain prayers to the *nagual* to protect the little one, and told the mother to take it daily to the same spot, where its *nagual* would appear to it, and would finally accompany it through all its life. Some, but not all, obtained the power of transforming themselves into the *nagual*, and the author declares that, though he could not cite such a case from his own experience, his father knew of several, and reliable priests, *religiosos de fé*, had told him enough examples to fill volumes.*

The tribes to which this author refers were the Cakchiquels and Quiches, who spoke practically the same tongue. An examination of some of the old dictionaries prepared by the early missionaries furnishes further and interesting information about this obscure subject.

In the Cakchiquel language of Guatemala, the word *naual* was applied both to the magician himself, to his necromantic art, and to the demonic agency which taught and protected him. This is shown by the following explanation, which I quote from Father Coto's *Vocabulario de la Lengua Cakchiquel*, 1651, a manuscript in the library of the American Philosophical Society:

"*Magic* or *Necromancy: puz* or *naual;* and they were accustomed to call their magicians or sorcerers by the same terms. It was a kind of magic which they invoked in order to transform themselves into eagles, lions, tigers, etc. Thus, they said, *ru puz, ru naual, pedro læ cot, balam,* 'Peter's power, his *naual*, is a lion, a tiger.' They also applied the words *puz* and *naual* to certain trees, rocks and other inanimate objects, whence the Devil used to speak to them, and likewise to the idols which they worshiped, as *gazlic che, gazlic abah, huyu, k'o ru naual,* 'The life of the tree, the life of the stone, of the hill, is its *naual,*' etc.; because they believed there was life in these objects. They used to have armies and

* *Historia de Guatemala, ó, Recordacion Florida*, Tom. ii, p. 44, *seq.*

soldiery to guard their lands, and the captains, as well as many who were not captains, had their *nauales*. They called the captain *ru g' alache; rohobachi, ti ru gaah, ru pocob, ru gh' amay a ghay ti be chi naualil* [he works magic with his shield, his lance, and his arrows].

"To practice such magical arts: *tin naualih* ('I practice magic'), an active verb. They use it, for instance, when a man asks his wife for something to eat or drink, and she has nothing, owing to his negligence, she will say: 'Where do you suppose I can get what you want? Do you expect me to perform miracles—*xa pe ri tin naualih*—that they shall come to my hands?' So when one is asked to lend or give something which he has not, he will exclaim: *Tin naualih pe ri puvak*, etc. ('Can I perform miracles,' etc.)

"It also signifies to pretend something, concealing the truth, as *xa ru naualim ara neh chu g' ux ri tzih tan tu bijh pedro*, 'Peter is feigning this which he is saying.' They are also accustomed to apply this word to the power which the priests exert (in the sacraments, etc.)."

A long and foolish account of the witchcraft supposed to be practiced among the Pokonchis of Guatemala, also a tribe of Mayan stock, is given by the Englishman, Thomas Gage, who was cura of a parish among them about 1630, and afterwards returned to England and Protestantism. He described, at wearisome length, the supposed metamorphosis of two chiefs of neighboring tribes, the one into a lion, the other into a tiger, and the mortal combat in which they engaged, resulting in the death of one to whom Gage administered absolution. No doubt he had been worsted in a personal encounter with his old enemy, and, being a man of eighty years, had not the vigor to recover. The account is of interest only as proving that the same superstitions at that time prevailed among the Pokonchis as in other portions of Guatemala.*

15. A really mighty nagualist was not confined to a single transformation. He could take on many and varied figures. One such is described in the sacred books of the Quiches of Guatemala, that document known by the name of the Popol Vuh, or National Book. The passage is in reference to one of their great kings and powerful magicians, Gucumatz by name. It says:

"Truly he was a wonderful king. Every seven days he ascended to the sky, and every seven days he followed the path to the abode of the

* Gage, *A New Survey of the West Indies*, p. 388, *seq.* (4th Ed.).

dead; every seven days he put on the nature of a serpent, and then he became truly a serpent; every seven days he assumed the nature of an eagle, and then he became truly an eagle; then of a tiger and he became truly a tiger; then of coagulated blood, and he was nothing else than coagulated blood."*

It may be said that such passages refer metaphorically to the versatility of his character, but even if this is so, the metaphors are drawn from the universal belief in Nagualism which then prevailed, and they do not express it too strongly.

16. Among the Maya tribes of Yucatan and Guatemala we have testimony to the continuance to this day of these beliefs. Father Bartolomé de Baeza, cura of Yaxcaba in the first half of this century, reports that an old man, in his dying confession, declared that by diabolical art he had transformed himself into an animal, doubtless his *nagual;* and a young girl of some twelve years confessed that she had been transformed into a bird by the witches, and in one of her nocturnal flights had rested on the roof of the very house in which the good priest resided, which was some two leagues from her home. He wisely suggests that, perhaps, listening to some tale of sorcery, she had had a vivid dream, in which she seemed to take this flight. It is obvious, however, from his account, as well as from other sources, that the belief of the transformation into lower animals was and is one familiar to the superstitions of the Mayas.† The natives still continue to propitiate the ancient gods of the harvest, at the beginning of the season assembling at a ceremony called by the Spaniards the *misa milpera*, or "field mass," and by themselves *ti'ch*, "the stretching out of the hands."

The German traveler, Dr. Scherzer, when he visited, in 1854, the remote hamlet of Istlavacan, in Guatemala, peopled by Quiché Indians, discovered that they had preserved in this respect the usages of their ancestors almost wholly unaffected by the teachings of their various Christian curates. The "Master" still assigned the *naguals* to the new-born infants, copal was burned to their ancient gods in remote caves, and formulas of

* *Le Popol Vuh, ou Livre Sacré des Quichés*, p. 315 (Ed. Brasseur, Paris, 1861). In the Quiche myths, Gucumatz is the analogue of Quetzalcoatl in Aztec legend. Both names mean the same, "Feathered Serpent."

† Baeza's article is printed in the *Registro Yucateco*, Vol. i, p. 165, *seq.*

invocation were taught by the veteran nagualists to their neophytes.*

These *Zahoris*,† as they are generally called in the Spanish of Central America, possessed many other mysterious arts besides that of such metamorphoses and of forecasting the future. They could make themselves invisible, and walk unseen among their enemies; they could in a moment transport themselves to distant places, and, as quickly returning, report what they had witnessed; they could create before the eyes of the spectator a river, a tree, a house, or an animal, where none such existed; they could cut open their own stomach, or lop a limb from another person, and immediately heal the wound or restore the severed member to its place; they could pierce themselves with knives and not bleed, or handle venomous serpents and not be bitten; they could cause mysterious sounds in the air, and fascinate animals and persons by their steady gaze; they could call visible and invisible spirits, and the spirits would come.

Among the native population of the State of Vera Cruz and elsewhere in southern Mexico these mysterious personages go by the name *padrinos*, godfathers, and are looked upon with a mixture of fear and respect. They are believed by the Indians to be able to cause sickness and domestic calamities, and are pronounced by intelligent whites to present "a combination of rascality, duplicity and trickery."‡

17. The details of the ceremonies and doctrines of Nagualism have never been fully revealed; but from isolated occurrences and partial confessions it is clear that its adherents formed a coherent association extending over most of southern

* "Wird ein Kind im Dorfe geboren, so erhält der heidnische Götzenpriester von diesem Ereignisse viel eher Kunde, als der katholische Pfarrer. Erst wenn dem neuen Weltbürger durch den Aj-quig das Horoskop gestellt, der Name irgend eines Thieres beigelegt, Mi-si-sal (das citronengelbe Harz des Rhus copallinum) verbrannt, ein Lieblingsgötze angerufen, und noche viele andere aberglaübische Mysterien verrichtet worden sind, wird das Kind nach dem Pfarrhause zur christlichen Taufe getragen. Das Thier, dessen Name dem Kinde kurz nach seiner Geburt vom Sonnenpriester beigelegt wird, gilt gewöhnlich auch als sein Schutzgeist (*nagual*) fürs ganze Leben." Dr. Karl Scherzer, *Die Indianer von Santa Catalina Istlavacan*, p. 11, Wien, 1856.

† The word *zahori*, of Arabic origin, is thus explained in the Spanish and English dictionary of Delpino (London, 1763): "So they call in Spain an impostor who pretends to see into the bowels of the earth, through stone walls, or into a man's body." Dr. Stoll says the Guatemala Indians speak of their diviners, the *Ah Kih*, as *zahorin*. *Guatemala*, s. 229.

‡ Emetorio Pineda, *Descripcion Geografica de Chiapas y Soconusco*, p. 22 (Mexico, 1845).

Mexico and Guatemala, which everywhere was inspired by two ruling sentiments—detestation of the Spaniards and hatred of the Christian religion.

In their eyes the latter was but a cloak for the exactions, massacres and oppressions exerted by the former. To them the sacraments of the Church were the outward signs of their own subjugation and misery. They revolted against these rites in open hatred, or received them with secret repugnance and contempt. In the Mexican figurative manuscripts composed after the conquest the rite of baptism is constantly depicted as the symbol of religious persecution. Says a sympathetic student of this subject:

"The act of baptism is always inserted in their records of battles and massacres. Everywhere it conveys the same idea,—making evident to the reader that the pretext for all the military expeditions of the Spaniards was the enforced conversion to Christianity of the natives; a pretext on which the Spaniards seized in order to possess themselves of the land and its treasure, to rob the Indians of their wives and daughters, to enslave them, and to spill their blood without remorse or remission. One of these documents, dated in 1526, adds a trait of savage irony. A Spanish soldier is represented dragging a fugitive Indian from a lake by a lasso around his neck; while on the shore stands a monk ready to baptize the recreant on his arrival!"*

No wonder that the priests of the dark ritual of Nagualism for centuries after the conquest sought to annul the effects of the hated Christian sacraments by counteracting ceremonies of their own, as we are told they did by the historian Torquemada, writing from his own point of view in these words:

"The Father of Lies had his ministers who aided him, magicians and sorcerers, who went about from town to town, persuading the simple people to that which the Enemy of Light desired. Those who believed their deceits, and had been baptized, were washed on the head and breast by these sorcerers, who assured them that this would remove the effects of the chrism and the holy oils. I myself knew an instance where a person of prominence, who resided not far from the City of Mexico, was dying, and had received extreme unction; and when the priest had departed one of these diabolical ceremonialists entered, and washed all the parts which had been anointed by the holy oil with the intention to destroy its power."†

* Madier de Montjau, "Manuscrits Figuratifs de l' Ancien Mexique," in *Archives de la Société Americaine de France*, 1875, p. 245.

† Torquemada, *Monarquia Indiana*, Lib. xv, cap. 16.

Similar instances are recorded by Jacinto de la Serna. He adds that not only did the Masters prescribe sacrifices to the Fire in order to annul the effects of extreme unction, but they delighted to caricature the Eucharist, dividing among their congregation a narcotic yellow mushroom for the bread, and the inebriating pulque for the wine. Sometimes they adroitly concealed in the pyx, alongside the holy wafer, some little idol of their own, so that they really followed their own superstitions while seemingly adoring the Host. They assigned a purely pagan sense to the sacred formula, "Father, Son and Holy Ghost," understanding it to be "Fire, Earth and Air," or the like.*

Whoever or whatever was an enemy to that religion so brutally forced upon these miserable creatures was to them an ally and a friend. Nuñez de la Vega tells us that he found written formulas among them reading: "O Brother Antichrist, Brother Antichrist, Brother Antichrist, come to our aid!"—pathetic and desperate appeal of a wretched race, ground to earth under the iron heels of a religious and military despotism.†

18. The association embraced various tribes and its members were classified under different degrees. The initiation into these was by solemn and often painful ceremonies. Local sodalities or brotherhoods were organized after the manner of those usual in the Roman Church; but instead of being named after St. John or the Virgin Mary they were dedicated to Judas Iscariot or Pontius Pilate out of derision and hatred of the teachings of the priests; or to the Devil or Antichrist, who were looked upon as powerful divinities in opposition to the Church.‡

There were certain recognized centres of the association, near which its most important dignitaries resided, and where their secret councils and most imposing ceremonies were held. One of these was Zamayac, in the province of Suchiltepec; a second near Huehuetan, Soconusco; a third at Totonicapan, Guate-

* De la Serna, *Manual de Ministros*, pp. 20, 21, 42, 162. The mushroom referred to was the *quauhnanacatl*, probably the same as the *teyhuinti* of Hernandez, *Hist. Plant. Nov. Hispan.*, Tom. ii, p. 358, who says that it is not dangerous to life, but disturbs the mind, inciting to laughter and intoxication.

† Actual slavery of the Indians in Mexico continued as late as the middle of the seventeenth century. See Cavo, *Tres Siglos de Mexico*, etc., Tom. ii, p. 11.

‡ Brasseur, *Hist. des Nations Civilisées de Mexique*, Tom. iv, p. 822.

mala; a fourth at Cancuc, Chiapas; a fifth at Teozapotlan, Oaxaca; and a few others may be surmised.

The high priest who resided at each of these centres exercised control over all the nagualistic teachers and practitioners in an extensive district. On the occasion of an official inquiry by the Spanish authorities it was ascertained that the high priest of Zamayac included under his rule nearly one thousand sub-priests,* and no doubt others of his rank were not less potent.

The unity between the members of the association over an indefinitely wide area was perfectly well known to the Spanish priests and civil authorities. The ceremonies, formulas and methods of procedure were everywhere identical or alike. This itself was justly regarded as a proof of the secret intelligence which existed among the members of this cabalistic guild.†

To a certain extent, and at least in some localities, as Chiapas and Guatemala, the priesthood of Nagualism was hereditary in particular families. This is especially stated by the historian Ordoñez y Aguiar, who had exceptional opportunities for acquainting himself with the facts.‡

A traveler of the first decade of this century, who has left us a number of curious details of the superstitions of the Christianized Indians in Mexico of that day, Benito Maria de Moxò, informs us that he had discovered the existence of different grades in the native soothsayers and medicine men, and that all in a given locality recognized the supremacy of one whom they referred to as "the little old man," *El Viejito*. But he was unable to ascertain by what superior traits or rights he obtained this distinction.§

According to some authorities, the highest grade of these native hierophants bore among the Nahuas the symbolic name

* *Informe del teniente general, Don Jacobo de Barba Figueroa, corregidor de la Provincia de Suchitepeque*, quoted by Brasseur.

† Jacinto de la Serna says: "Los mæstros de estas ceremonias son todos unos, y lo que sucede en esta cordillera en todas sucede." *Manual de Ministros*, p. 52. Speaking of the methods of the nagualists of Chiapas, Bishop Nuñez de la Vega writes: "Concuerdan los mas modernos con los mas antiguos que se practicaban en Mexico." *Constituciones Diocesanas*, p. 134.

‡ He observes that there were "familias de los tales sabios en las quales en manera de patrimonio se heredaban, succediendo los hijos á los padres, y principalmente su abominable secta de Nagualismo." *Historia del Cielo y de la Tierra*, MS., p. 7. Ordoñez advances various erudite reasons for believing that Nagualism is a religious belief whose theory and rites were brought from Carthage by Punic navigators in ancient times.

§ Maria de Moxó, *Cartas Mejicanas*, p. 270 (Genova, n. d.).

of "flower-weavers," *Xochimilca*, probably from the skill they had to deceive the senses by strange and pleasant visions.* In the south they were spoken of as "guardians," which may have been derived from the classes of priests so-called in the Zapotec religion.†

19. It will be seen from the above, that Nagualism, beginning in an ancient superstition dating back to the time of primitive barbarism, became after the Conquest a potent factor in the political and social development of the peoples among whom it existed; that it was the source from which was drawn and the means by which was sustained the race-hatred of the native American towards his foreign conquerors, smouldering for centuries, now and then breaking out in furious revolt and civil war.

There is strong reason to suspect its power where, for obvious reasons, it has not been demonstrated. It has always been a mystery and a matter of surprise to the historians of Yucatan how rapidly spread the plans of the insurrection which secured lasting independence for the natives, after these plans had been agreed upon by the two chiefs, Antonio Ay and Cecilio Chi, at the remote rancho of Xihum, in July, 1847. Such unanimity of action could only have been possible through the aid of a powerful, well-disciplined and widespread secret organization. There can scarcely be a doubt they were the chiefs or masters of the redoubtable order of Nagualism in the Peninsula.‡

There is no question that such was the case with the brief and bloody revolt of the Mayas in 1761. It suddenly broke out in a number of villages near Valladolid, Yucatan, headed by a full-blood native, Jacinto Can-Ek; but some of the participants afterwards confessed that it was the outcome of a conspiracy which had been preparing for a year.

When the appointed day arrived, Jacinto boldly announced himself as the high priest of the fraternity of sorcerers, a master and teacher of magic, and the lineal successor of the famous

* "*Xochimilca*, que asi llamavan à los mui sabios encantadores." Torquemada, *Monarquia Indiana*, Lib. xv, cap. 16.

† In Nahuatl, *tlapiani*, a guardian or watchman. The Zapotec priesthood was divided into the *huijatoos*, "greater guardians," and their inferiors, the *copavitoos*, "guardians of the gods." Carriedo, *Estudios Historicòs*, p. 93.

‡ See Eligio Ancona, *Historia de Yucatan*, Tom. iv, cap. 1 (Mérida, 1880).

ancient prophet, Chilan Balam, "whose words cannot fail." In a stirring appeal he urged his fellow-countrymen to attack the Spaniards without fear of consequences.

"'Be not afraid,' he exclaimed, 'of their cannons and their forts; for among the many to whom I have taught the arts of magic (el arte de brujeria) there are fifteen chosen ones, marvelous experts, who by their mystic power will enter the fortress, slay the sentinels, and throw open the gates to our warriors. I shall take the leaves of the sacred tree, and folding them into trumpets, I shall call to the four winds of heaven, and a multitude of fighting men will hasten to our aid.'"*

Saying this, he took a sheet of paper, held it up to show that it was blank, folded it for a moment, and then spread it out covered with writing! This deft trick convinced his simple-minded hearers of the truth of his claims and they rushed to arms. He led them, clothed in the robe of the Virgin and with her crown on his head. But neither their enthusiasm nor their leader's art magic availed, and soon Jacinto and his followers fell victims to the stake and the gallows. After their death the dance of "the tiger," or of Chac-Mool—the "ghost dance" of the Mayas—was prohibited; and the use of the sacred drum—the favorite instrument of the native priests—was forbidden.†

In fact, wherever we have any full accounts of the revolts against the Spanish domination during the three centuries of its existence in New Spain, we can manifestly trace the guiding fingers of the powerful though hidden hand of Nagualism. An earlier revolt of the Mayas in Yucatan occurred in 1585. It was led by Andres Chi, a full-blood Indian, and a descendant of the ancient royal house of the Cocomes. He also announced himself as a priest of the ancient faith, a prophet and a worker of miracles, sent to instruct his own people in a new religion and to give them an independent political existence. Seized by

* The mention of the fifteen, 5 x 3, chosen disciples indicates that the same system of initiating by triplets prevailed in Yucatan as in Chiapas (see above, p. 27). The sacred tree is not named, but presumably it was the ceiba to which I refer elsewhere. The address of Jacinto was obtained from those present, and is given at length by the Jesuit Martin del Puerto, in his *Relacion hecho al Cabildo Eclesiastico por el preposito de la Compañia de Jesus, acerca de la muerte de Jacinto Can-Ek y socios*, Dec. 26, 1761. It is published, with other documents relating to this revolt, in the Appendix to the *Diccionario Universal*, edited by Orozco y Berra, Mexico, 1856. On the prophecies of Chilan Balam, see my *Essays of an Americanist*, pp. 255–273 (Philadelphia, 1890).

† Eligio Ancona, *Hist. de Yucatan*, Tom. ii, p. 152.

the Spaniards, he was charged with idolatry, sorcery and disturbing the peace, and was ignominiously hanged.*

Not less definitely inspired by the same ideas was the Mixe Indian, known as "Don Pascual," who led the revolt of the Tehuantepec tribes in 1661. He sent out his summons to the "thirteen governors of the Zapotecs and Chontales" to come to his aid, and the insurrection threatened to assume formidable proportions, prevented only by bringing to bear upon the natives the whole power of the Roman Church through the Bishop of Oaxaca, Cuevas Davalos.†

Nearly the same locality had been the scene of the revolt of the Zapotecs in 1550, when they were led by a native priest who claimed to be an incarnation of the old god Quetzalcoatl, the patron deity of the nagualists.‡

In the city of Mexico itself, in the year 1692, there was a violent outbreak of the natives, when they destroyed three million dollars worth of property. Doubtless this was partly attributable to the scarcity of food which prevailed; but that the authorities traced it also to some secret ceremonials is evident from the law which was immediately passed forbidding the Indians to wear the *piochtli*, or scalp-lock, a portion of the hair preserved from birth as part of the genethliac rituals,§ and the especial enactments against the *octli*.

As for the revolt of the Tzentals of Chiapas, in 1712, it was clearly and confessedly under the leadership of the nagualistic priesthood, as I shall indicate on a later page.

The history of the native American race under the Spanish power in North America has never yet been written with the slightest approach to thoroughness. He who properly qualifies

* See Pedro Sanchez de Aguilar, *Informe contra Idolum Cultores en Yucathan* (Madrid, 1639); Eligio Ancona, *Historia de Yucatan*, Tom. ii, pp. 128, 129.

† The chief authority on this revolt is Juan de Torres Castillo, *Relacion de lo Sucedido en las Provincias de Nexapa, Iztepex y Villa Alta* (Mexico, 1662). See also Cavo, *Los Tres Siglos de Mexico durante el Gobierno Español*, Tom. ii, p. 41, and a pamphlet by Christoval Manso de Contreras, *Relacion cierta y verdadera de lo que sucedio en esta Provincia de Tehuantepec*, etc. (printed at Mexico, 1661), which I know only through the notes of Dr. Berendt. Mr. H. H. Bancroft, in his very meagre account of this event, mistakingly insists that it took place in 1660. *History of Mexico*, Vol. iii, p. 164.

‡ See Brasseur de Bourbourg, *Histoire des Nations Civilisées de la Mexique*, Tom iv, 824.

§ Cavo, *Los Tres Siglos*, etc., Tom. ii, p. 82. On the use and significance of the *piochtli* we have some information in Vetancurt, *Teatro Mexicano*, Tom. ii, p. 464, and de la Serna, *Manual de Ministros*, pp. 166, 167. It was the badge of a certain order of the native priesthood.

himself for that task will certainly reach the conclusion expressed a number of years ago by the eminent American antiquary and historian, Mr. E. G. Squier, in these words:

"Among the ruling and priestly classes of the semi-civilized nations of America, there has always existed a mysterious bond, a secret organization, which all the disasters to which they have been subjected have not destroyed. It is to its present existence that we may attribute those simultaneous movements of the aborigines of Mexico and Central America, which have more than once threatened the complete subversion of the Spanish power."*

That mysterious bond, that secret organization, is *Nagualism.*

20. A remarkable feature in this mysterious society was the exalted position it assigned to Women. Not only were they admitted to the most esoteric degrees, but in repeated instances they occupied the very highest posts in the organization. According to the traditions of the Tzentals and Pipils of Chiapas, when their national hero, Votan, constructed by the breath of his mouth his darkened shrine at Tlazoaloyan, in Soconusco, he deposited in it the sacred books and holy relics, and constituted a college of venerable sages to be its guardians; but placed them all in subjection to a high priestess, whose powers were absolute.†

The veracious Pascual de Andagoya asserts from his own knowledge that some of these female adepts had attained the rare and peculiar power of being in two places at once, as much as a league and a half apart;‡ and the repeated references to them in the Spanish writings of the sixteenth and seventeenth centuries confirm the dread in which they were held and the extensive influence they were known to control. In the sacraments of Nagualism, Woman was the primate and hierophant.

21. This was a lineal inheritance from pre-Columbian times. In many native American legends, as in others from the old world, some powerful enchantress is remembered as the founder of the State, mistress of men through the potency of her magic powers.

* *Adventures on the Musquito Shore*, by S. A. Ward, pseudonym of Mr. Squier, p. 258 (New York, 1855).

† Nuñez de la Vega, *Constituciones Diocesanas*, p. 10, and comp. Brasseur de Bourbourg, *Hist. des Nat. Civ. de Mexique*, Tom. i, p. 74.

‡ Herrera, *Hist. de las Indias Occidentales*, Dec. ii, Lib. iii, cap. 5.

Such, among the Aztecs, was the sorceress who built the city of Mallinalco, on the road from Mexico to Michoacan, famous even after the conquest for the skill of its magicians, who claimed descent from her.* Such, in Honduras, was Coamizagual, queen of Cerquin, versed in all occult science, who died not, but at the close of her earthly career rose to heaven in the form of a beautiful bird, amid the roll of thunder and the flash of lightning.†

According to an author intimately familiar with the Mexican nagualists, the art they claimed to possess of transforming themselves into the lower animals was taught their predecessors by a woman, a native Circe, a mighty enchantress, whose usual name was Quilaztli (the etymology of which is unknown), but who bore also four others, representing her four metamorphoses, Cohuacihuatl, the Serpent Woman; Quauhcihuatl, the Eagle Woman; Yaocihuatl, the Warrior Woman: and Tzitzimecihuatl, the Specter Woman.‡

The powers of these queens of magic extended widely among their sex. We read in the chronicles of ancient Mexico that when Nezahualpilli, the king, oppressed the tribes of the coast, the *tierra caliente*, they sent against him, not their warriors, but their witches. These cast upon him their fatal spells, so that when he walked forth from his palace, blood burst from his mouth, and he fell prone and dead.§

In Guatemala, as in ancient Delphos, the gods were believed to speak through the mouths of these inspired seeresses, and at the celebration of victories they enjoyed a privilege so strange and horrible that I quote it from the old manuscript before me without venturing a translation:

". . . . Despues de sacrificar los antiguos algun hombre, despedaçandolo, si era de los que avian cogido en guerra, dicen que guardaban el

* Acosta, *Hist. Nat. y Moral de las Indias*, Lib. vii, cap. 5.

† The story is given in Herrera, *Hist. de las Indias*, Dec. iv, Lib. viii, cap. 4. The name Coamizagual is translated in the account as "Flying Tigress." I cannot assign it this sense in any dialect.

‡ Jacinto de la Serna, *Manual de Ministros*, p. 138. Sahagun identifies Quilaztli with Tonantzin, the common mother of mankind and goddess of child-birth (*Hist. de Nueva España*, Lib. i, cap. 6, Lib. vi, cap. 27). Further particulars of her are related by Torquemada, *Monarquia Indiana*, Lib. ii, cap. 2. The *tzitzime* were mysterious elemental powers, who, the Nahuas believed, were destined finally to destroy the present world (Sahagun, l. c., Lib. vi, cap. 8). The word means "flying haired" (Serna).

§ Torquemada, *Monarquia Indiana*, Lib. ii, cap. 62.

miembro genital y los testiculos del tal sacrificado, y se los daban à una vieja que tenian por profeta, para que los comiese, y le pedian rogasse à su idolo les diesse mas captivos." *

When Captain Pedro de Alvarado, in the year 1524, was marching upon Quetzaltanango, in Guatemala, just such a fearful old witch took her stand at the summit of the pass, with her familiar in the shape of a dog, and "by spells and nagualistic incantations" undertook to prevent his approach.†

As in the earliest, so in the latest accounts. The last revolt of the Indians of Chiapas occurred among the Zotzils in 1869. The cause of it was the seizure and imprisonment by the Spanish authorities of a "mystical woman," known to the whites as Santa Rosa, who, together with one of their *ahaus* or chieftains, had been suspected of fomenting sedition. The natives marched thousands strong against the city of San Cristobal, where the prisoners were, and secured their liberation; but their leader, Ignacio Galindo, was entrapped and shot by the Spaniards, and the mutiny was soon quelled.‡

22. But perhaps the most striking instance is that recorded in the history of the insurrection of the Tzentals of Chiapas, in 1713. They were led by an Indian girl, a native Joan of Arc, fired by like enthusiasm to drive from her country the hated foreign oppressors, and to destroy every vestige of their presence. She was scarcely twenty years old, and was known to the Spaniards as Maria Candelaria. She was the leader of what most historians call a religious sect, but what Ordoñez y Aguiar, himself a native of Chiapas, recognizes as the powerful secret association of Nagualism, determined on the extirpation of the white race. He estimates that in Chiapas alone there were nearly seventy thousand natives under her orders—doubtless an exaggeration—and asserts that the conspiracy extended far into

* Fr. Tomas Coto, *Diccionario de la Lengua Cakchiquel*, MS., s. v. *Sacrificar;* in the Library of the American Philosophical Society at Philadelphia.

† "Trataron de valerse del arte de los encantos y *naguales*" are the words of the author, Fuentes y Guzman, in his *Recordacion Florida*, Tom. i, p. 50. In the account of Bernal Diaz, it reads as if this witch and her dog had both been sacrificed; but Fuentes is clear in his statement, and had other documents at hand.

‡ Teobert Maler, "Mémoire sur l'Etat de Chiapas," in the *Révue d' Ethnographie*, Tom. iii, pp. 309-311. This writer also gives some valuable facts about the Indian insurrection in the Sierra de Alicia, in 1873.

the neighboring tribes, who had been ordered to await the result of the effort in Chiapas.

Her authority was absolute, and she was merciless in requiring obedience to it. The disobedient were flayed alive or roasted over a slow fire. She and all her followers took particular pleasure in manifesting their hatred and contempt for the religion of their oppressors. They defiled the sacred vessels of the churches, imitated with buffoonery the ceremonies of the mass, which she herself performed, and stoned to death the priests whom they caught.

Of course, her attempt against the power of Spain was hopeless. It failed after a bitter and protracted conquest, characterized by the utmost inhumanity on both sides. But when her followers were scattered and killed, when the victorious whites had again in their hands all the power and resources of the country, not their most diligent search, nor the temptation of any reward, enabled them to capture Maria Candelaria, the heroine of the bloody drama. With a few trusty followers she escaped to the forest, and was never again heard of.*

More unfortunate were her friends and lieutenants, the priestesses of Guistiupan and Yajalon, who had valiantly seconded Maria in her patriotic endeavors. Seized by the Spaniards, they met the fate which we can easily imagine, though the historian has mercifully thrown a veil on its details.†

23. Of just such a youthful prophetess did Mr. E. G. Squier hear during his travels in Central America, a "*sukia* woman," as she was called by the coast Indians, one who lived alone mid the ruins of an old Maya temple, a sorceress of twenty years, loved and feared, holding death and life in her hands.‡ Per-

* The long account given by Mr. H. H. Bancroft of this insurrection is a travesty of the situation drawn from bitterly prejudiced Spanish sources, of course, utterly out of sympathy with the motives which prompted the native actors. See his *History of the Pacific States*, Vol. ii, p. 696, *sqq*. Ordoñez y Aguiar, who lived on the spot within a generation of the occurrences, recognizes in Maria Candelaria (whose true name Bancroft does not give) the real head of the rebellion, "quien ordenaba los ardides del motin; . . . . de lo que principalmente trataban las leyes fundamentales de su secta, era de que no quedase rastro alguno de que los Europeos havian pisado este suelo." His account is in his unpublished work, *Historia del Cielo y de la Tierra*, written at Guatemala about 1780. Juarros, speaking of their rites, says of them: "Apostando de la fé, profanando los vasos sagrados, y ofreciendo sacrilegos cultos á una indizuela." *Historia de la Ciudad de Guatemala*, Tom. i, p. 17.

† Bancroft, ubi suprà, p. 705, note. One was hanged, whom Garcia Pelaez calls "una india bruja." *Memorias para la Historia de Guatemala*, Tom. ii, p. 153.

‡ Squier, ubi suprà, passim.

haps his account is somewhat fanciful; it is so, indeed; but it is grounded on the unshaken beliefs and ancient traditions of the natives of those climes, and on customs well known to those who reside there.

The late distinguished Americanist, the Abbé Brasseur de Bourbourg, during his long travels in Mexico and Central America, had occasion more than once to come in contact with this trait of the ancient faith of the Nagualists, still alive in their descendants. Among the Zapotecs of the Isthmus of Tehuantepec he saw one of the queens of the mystic fraternity, and he describes her with a warmth which proves that he had not lost his eye for the beautiful.

"She wore a piece of light-green stuff loosely folded around her form at the hips, and falling to a little distance above the ankle; a jacket of red silk gauze with short sleeves and embroidered with gold, clothed the upper part of her person, veiling her bosom, upon which lay a chain of heavy gold pieces, pierced and strung on a cord. Her rich black hair was divided on the forehead, and drawn back in two splendid tresses fastened with blue ribbons, while a white muslin kerchief encircled her head like the calantica of the ancient Egyptians. Never in my life have I seen a more striking figure of an Isis or a Cleopatra.

"There was something strange in her expression. Her eyes were the blackest and the brightest in the world; but there were moments when she suddenly paused, leaned against the billiard table or the wall, and they became fixed and dead like those of a corpse. Then a fiery glance would shoot from beneath her dark lashes, sending a chill to the heart of the one to whom it was directed. Was it madness, or was it, as those around her believed, a momentary absence of soul, an absorption of her spirit into its *nagual*, a transportation into an unknown world? Who shall decide?"* .

24. It would be a mistake to suppose that Nagualism was an incoherent medley of superstitions, a mass of jumbled fragments derived from the ancient paganism. My study of it has led me to a widely different conclusion. It was a perpetuation of a well-defined portion of the native cult, whose sources we are able to trace long anterior to the period of the conquest, and which had no connection with the elaborate and bloody ritual of the Aztecs. The evidence to this effect is cogent.

Wherever in later days the Catholic priests found out the

* *Voyage á l'Isthmus de Tehuantepec*, p. 164. He adds a number of particulars of the power she was supposed to exercise.

holy places and sacred objects of the nagualists, they were in caves or deep rock-recesses, not in artificial structures. The myths they gleaned, and the names of the gods they heard, also point to this as a distinguishing peculiarity. An early instance is recorded among the Nahuas of Mexico. In 1537 Father Perea discovered a cavern in a deep ravine at Chalma, near Malinalco (a town famous for its magicians), which was the sanctuary of the deity called *Oztoteotl*, the Cave God (*oztotl*, cave; *teotl*, god), "venerated throughout the whole empire of Montezuma."* He destroyed the image of the god, and converted the cavern into a chapel.

We cannot err in regarding Oztoteotl as merely another name of the Nahuatl divinity, Tepeyollotl, the Heart, or Inside, of the Mountain, who in the Codex Borgia and the Codex Vaticanus is represented seated upon or in a cavern. His name may equally well be translated "the Heart of the Place," or "of the Town."

Dr. Eduard Seler has shown beyond reasonable question that this divinity did not originally belong to the Aztec Pantheon, but was introduced from the South, either from the Zapotecs, the Mixtecs, or the Mayan tribes, beyond these.† The Cave God of the Aztecs is identical with the Votan of the Tzentals of Chiapas, and with the U-q'ux Uleuh of the Quiches of Guatemala, and probably with the Cozaana of the Zapotecs.

The rites of all of these were conducted in caverns, and there have been preserved several interesting descriptions of the contents of these sacred places. That relating to the "dark house of Votan" is given thus in the work of the Bishop of Chiapas:

"Votan is the third hero who is named in the calendar, and some of his descendants still reside in the town of Teopisca, where they are known as Votans. He is sometimes referred to as Lord of the Sacred Drum, and he is said to have seen the great wall (which must have been the Tower of Babel), and to have divided this land among the Indians, and given to each tribe its language.

* "Que era venerado en todo el imperio de Montezuma." See *Diccionario Universal*, Appendice, s. v. (Mexico, 1856).

† "Dass der Gott Tepeyollotl im Zapotekenlande und weiter südwärts seine Wurzeln hat, und dem eigentlichen Aztekischen Olymp fremd ist, darüber kann kein Zweifel mehr obwalten." See Dr. Seler's able discussion of the subject in the *Compte-Rendu* of the Seventh International Congress of Americanists, p. 559, *seq.* The adoption of subterranean temples was peculiarly a Zapotecan trait. "Notandose principalmênte en muchos adoratorios de los Zapotecos, estan los mas de ellos cubiertos, ò en subterraneos espaciosos y lòbregos." Carriedo, *Estudios Historicos*, Tom. i, p. 26.

"They say further that he once dwelt in Huehuetan, a town in the province of Soconusco. Near there, at the place called Tlazoaloyan, he constructed, by blowing with his breath, a dark house, and put tapirs in the river, and in the house a great treasure, and left all in charge of a noble lady, assisted by guardians (*tlapiane*) to preserve. This treasure consisted of earthenware vases with covers of the same material; a stone, on which were inscribed the figures of the ancient native heroes as found in the calendar; *chalchiuites*, which are green stones; and other superstitious objects.

"All of these were taken from the cave, and publicly burned in the plaza of Huehuetan on the occasion of our first diocesan visit there in 1691, having been delivered to us by the lady in charge and the guardians. All the Indians have great respect for this Votan, and in some places they call him 'the Heart of the Towns.'"*

The English priest, Thomas Gage, who was curate of a parish among the Pokonchi Indians of Guatemala about 1630, relates his discovery of such a cave, in which the idol was preserved, and gives this description of it:

"We found the Idol standing upon a low stool covered with a linen cloth. The substance of it was wood, black shining like jet, as if it had been painted or smoked; the form was of a man's head unto the shoulders, without either Beard or Mustachoes; his look was grim, with a wrinkled forehead, and broad staring eyes.

"They boasted of this their god, saying that he had plainly told them they should not believe anything I preached of Christ, but follow the old ways of their forefathers."†

The black color here mentioned was a relic of ancient symbolism, referring to the night, darkness, and the obscurity of the holy cavern. Vetancurt informs us that the priests of the ancient paganism were accustomed to rub their faces and bodies with an ointment of fat and pine soot when they went to sacrifice in the forests, so that they looked as black as negroes ‡ In the extract from Nuñez de la Vega already given, *Ical Ahau*, the "Black King," is named as one of the divinities of the nagualists.

In some parts the principal idol found in the caves was the

* *Constituciones Diocesanas*, pp. 9, 10.

† Gage, *A New Survey of the West Indies*, pp. 389, 393.

‡ *Teatro Mexicano*, Tratado iii, cap. 11. Mr. Bandelier has called attention to the naming of one of the principal chiefs among the Aztecs, *Tlilancalqui*, "Man of the Dark House," and thinks it related to the Votan myth. *Twelfth Annual Report of the Peabody Museum*, p. 689.

mummied or exsiccated body of some former distinguished priest or chieftain. One such is recorded by Bartholomé de Pisa, which was found among the Zapotecs of Coatlan. It bore a name taken from the calendar, that of the tenth day, and was alleged to be the preserved cadaver of a celebrated ruler.* Another interesting example is narrated by Villa Señor y Sanchez,† who describes it as an eye-witness. It was discovered in a spacious cave located some distance to the west of the city of Mexico, in Nahuatl territory, on the side of what was known as "the Sun mountain"—*la Mesa de Tonati.* He speaks of it as remarkably well preserved, "both the muscles and the bones."

"It was seated in an armchair which served for a throne, and was clothed in a mantle, which fell from the shoulders to the feet. This was richly adorned with precious stones, which, according to the native custom, were sewed into the texture of the cloth. The figure also wore shoulder straps, collars, bracelets and fastenings of silver. From its forehead rose a crown of beautiful feathers of different colors arranged so that one color should alternate with another. The left hand was resting on the arm of the chair, while in the right was a sharp cutlass with silver mountings. At its feet were several vases of fine stone, as marble and alabaster, in which were offerings of blood and meat, obtained from the sacrifices."

The same writer refers to other examples of these sacred caves which he had seen in his journeys. One was near the town of Teremendo, where the sides and roof had been artificially dressed into the shape of huge arches. A natural altar had been provided in a similar manner, and on it, at the time of his visit, were numerous idols in the figures of men and animals, and before them fresh offerings of copal and food. Elsewhere he refers to many such caverns still in use as places resorted to by the natives in *la gran Sierra de Tlascala.*‡

These extracts prove the extent of this peculiar worship and the number of these subterranean temples in recent generations. The fame of some of the greater ones of the past still survives, as the vast grotto of Chalcatongo, near Achiutla, which was the sepulchral vault of its ancient kings; that of Totomachiapa, a

* Herrera, *Historia de las Indias Occidentales,* Dec. iii, Lib. iii, cap. 14.

† Villa Señor, *Teatro Americano,* Lib. v, cap. 38 (Mexico, 1747). Father Cavo adds that there were signs of human sacrifices present, but of this I can find no evidence in the earlier reports. Comp. Cavo, *Los Tres Siglos de Mexico durante el Gobierno Español,* Tom. ii, p. 128.

‡ *Teatro Americano,* Lib. ii, cap. 11; Lib. iii, cap. 13.

solemn scene of sacrifice for the ancient priests; that of Justlahuaca, near Sola (Oaxaca), which was a place of worship of the Zapotecs long after the Conquest; and that in the Cerro de Monopostiac, near San Francisco del Mar. *

The intimate meaning of this cave-cult was the worship of the Earth. The Cave God, the Heart of the Hills, really typified the Earth, the Soil, from whose dark recesses flow the limpid streams and spring the tender shoots of the food-plants, as well as the great trees. To the native Mexican, the Earth was the provider of food and drink, the common Father of All; so that to this day, when he would take a solemn oath, he stoops to the earth, touches it with his hand, and repeats the solemn formula: *Cuix amo nechitla in toteotzin?* "Does not our Great God see me?"

25. The identity of the Tepeyollotl of the Nahuas and the Votan of the Tzentals is shown not only in the oneness of meaning of the names, but in the fact that both represent the *third* day in the ritual calendar. For this reason I take it, we find the number *three* so generally a sacred number in the symbolism of the nagualists. We have already learned in the extract from Nuñez de la Vega that the neophytes were instructed in classes of three. To this day in Soteapan the fasts and festivals appointed by the native ministrants are three days in duration.† The semi-Christianized inhabitants of the Sierra of Nayerit, the Nahuatl-speaking Chotas, continued in the last century to venerate three divinities, the Dawn, the Stone and the Serpent;‡ analogous to a similar "trinity" noted by Father Duran among the ancient Aztecs.§

The number *nine*, that is, 3 x 3, recurs so frequently in the conjuration formulas of the Mexican sorcerers that de la Serna exclaims: "It was the Devil himself who inculcated into them this superstition about the number nine."‖

* See Mühlenpfordt, *Mexico*, Bd. ii, pp. 200-266; Brasseur, *Hist. des Nations Civ. de la Mexique*, Vol. iv, p. 821; Herrera, *Historia de las Indias*, Dec. iii, Lib. iii, cap. 12, etc.

† *Diccionario Universal*, Appendice, s. v.

‡ Their names were Ta Yoapa, Father Dawn; Ta Te, Father Stone; Coanamoa, the Serpent which Seizes. *Dicc. Univ.*, App., Tom. iii, p. 11.

§ Duran, *Historia de los Indios*, Tom. ii, p. 140. They were Tota, Our Father; Yollometli, the Heart of the Maguey (probably pulque); and Topiltzin, Our Noble One (probably Quetzalcoatl, to whom this epithet was often applied).

‖ "Fue el Demonio que les dió la superstición del numero nueve." *Manual de Ministros*, p. 197.

The other number sacred to the nagualists was *seven*. I have, in a former essay, given various reasons for believing that this was not derived from the seven days of the Christian week, but directly from the native calendar.* Nuñez de la Vega tells us that the patron of the seventh day was *Cuculcan*, "the Feathered Serpent," and that many nagualists chose him as their special protector. As already seen, in Guatemala the child finally accepted its *naual* when seven years old; and among some of the Nahuatl tribes of Mexico the *tonal* and the calendar name was formally assigned on the seventh day after birth.† From similar impressions the Cakchiquels of Guatemala maintained that when the lightning strikes the earth the "thunder stone" sinks into the soil, but rises to the surface after seven years. ‡

The three and the seven were the ruling numbers in the genealogical trees of the Pipiles of San Salvador. The "tree" was painted with *seven* branches representing degrees of relationship within which marriage was forbidden unless a man had performed some distinguished exploit in war, when he could marry beyond the nearest *three* degrees of relationship.§ Another combination of 3 and 7, by multiplication, explains the customs among the Mixes of deserting for 21 days a house in which a death has occurred. ‖

The indications are that the nagualists derived these numbers from the third and seventh days of the calendar "month" of twenty days. Tepeololtec, the Cave God, was patron of the third day and also "Lord of Animals," the transformation into which was the test of nagualistic power.¶ Tlaloc, god of the mountains and the rains, to whom the seventh day was hallowed, was represented by the nagualistic symbol of a snake doubled and twisted on itself, and was generally portrayed in connection with the "Feathered Serpent" (Quetzalcoatl, Cuculchan, Gukumatz, all names meaning this), represented as carrying his medicine bag, *xiquipilli*, and incensory, the apparatus of the

* *The Native Calendar of Central America and Mexico*, p. 12.

† Motolinia, *Ritos Antiguos, Sacrificios e Idolatrias de los Indios de la Nueva España*, p. 340 (in *Coleccion de Documentos inéditos para la Historia de España*).

‡ Thomas Coto, *Vocabulario de la lengua Cakchiquel*, MS., sub voce, *Rayo*.

§ Herrera, *Historia de las Indias*, Dec. iv, Lib. viii, cap. 10.

‖ *Diccionario Universal*, Appendice, ubi suprá.

¶ "Señor de los Animales." *Codex Telleriano-Remensis*, Parte ii, Lam. iv.

native illuminati, his robe marked with the sign of the cross to show that he was Lord of the Four Winds and of Life. *

26. The nagualistic rites were highly symbolic, and the symbols used had clearly defined meanings, which enable us to analyze the religious ideas underlying this mysterious cult.

The most important symbol was Fire. It was regarded as the primal element and the immediate source of life. Father Nicolas de Leon has the following suggestive passage in this connection:

"If any of their old superstitions has remained more deeply rooted than another in the hearts of these Indians, both men and women, it is this about fire and its worship, and about making new fire and preserving it for a year in secret places. We should be on the watch for this, and when in their confessions they speak of what the Fire said and how the Fire wept, expressions which we are apt to pass by as unintelligible, we must lay our hands on them for reprehension. We should also be on the watch for their baptism by Fire, a ceremony called the *yiahuiltoca*,† shortly after the birth of a child when they bestow on it the surnames; nor must the lying-in women and their assistants be permitted to speak of Fire as the father and mother of all things and the author of nature; because it is a common saying with them that Fire is present at the birth and death of every creature."

This curious ceremony derived its name from the *yiahuitli*, a plant not unlike the absinthe, the powdered leaves of which, according to Father Sahagun, the natives were accustomed to throw into the flames as an offering to the fire.‡ Long after the conquest, and probably to this day, the same custom prevails in Mexico, the fumes and odor of the burning leaves being considered very salubrious and purifying to the air of the sick room §

* See Dr. Seler's minute description in the *Compte Rendu* of the Eighth Session of the Congrés International des Américanistes, pp. 588, 589. In one of the conjuration formulas given by de la Serna (*Manual de Ministros*, p. 212) the priest says: "Yo soy el sacerdote, el dios *Quetzalcoatl*, que se bajará al infierno, y subiré á lo superior, y hasta los nueve infiernos." This writer, who was very competent in the Nahuatl, translates the name Quetzalcoatl by "culebra con cresta" (*id.*, p. 171), an unusual, but perhaps a correct rendering.

† His words here are somewhat obscure. They are, "El baptismo de fuego, en donde las ponen los sobre nombres que llaman *yahuiltoca*, quando nacen." This may be translated, "The baptism of fire in which they confer the names which they call *yahuiltoca*." The obscurity is in the Nahuatl, as the word *toca* may be a plural of *tocaitl*, name, as well as the verb *toca*, to throw upon. The passage is from the *Camino del Cielo*, fol. 100, verso.

‡ Sahagun, *Historia de la Nueva España*, Lib. iv, cap. 25.

§ It is mentioned as useful for this purpose by the early physicians, Francisco Ximenes, *Cuatro Libros de la Naturaleza*, p. 144; Hernandez, *Hist. Plant. Novæ Hispaniæ*, Tom.

The word *yiahuiltoca* means "the throwing of the *yiauhtli*" (from *toca*, to throw upon with the hands). Another name for the ceremony, according to Father Vetancurt, who wrote a century later than Leon, was *apehualco*, which has substantially the same meaning, "a throwing upon" or "a throwing away." * He adds the interesting particulars that it was celebrated on the fourth day after the birth of the child, during which time it was deemed essential to keep the fire burning in the house, but not to permit any of it to be carried out, as that would bring bad luck to the child.

Jacinto de la Serna also describes this ceremony, to which he gives the name *tlecuixtliliztli*, "which means that they pass the infant over the fire;" and elsewhere he adds: "The worship of fire is the greatest stumbling-block to these wretched idolaters."†

27. Other ceremonies connected with fire worship took place in connection with the manufacture of the pulque, or *octli*, the fermented liquor obtained from the sap of the maguey plant. The writer just quoted, de Vetancurt, states that the natives in his day, when they had brewed the new pulque and it was ready to be drunk, first built a fire, walked in procession around it and threw some of the new liquor into the flames, chanting the while an invocation to the god of inebriation, Tezcatzoncatl, to descend and be present with them.

This was distinctly a survival of an ancient doctrine which connected the God of Fire with the Gods of Drunkenness, as we may gather from the following quotation from the history composed by Father Diego Duran:

"The *octli* was a favorite offering to the gods, and especially to the God of Fire. Sometimes it was placed before a fire in vases, sometimes

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II, p. 200. Capt. Bourke, in his recent article on "The Medicine Men of the Apaches" (in *Ninth Annual Report of the Bureau of Ethnology*, p. 521), suggests that the *yiahuilli* of the Aztecs is the same as the "hoddentin," the pollen of a variety of cat-tail rush which the Apaches in a similar manner throw into the fire as an offering. Hernandez, however, describes the *yiahuilli* as a plant with red flowers, growing on mountains and hill-sides—no species of rush, therefore. De la Serna says it is the anise plant, and that with it the natives perform the conjuration of the "yellow spirit" (conjuro de amarillo espiritado), that is, of the Fire (*Manual de Ministros*, p. 197).

* From the verb *apeua*. Vetancurt's description is in his *Teatro Mexicano*, Tom. I, pp. 462, 463 (Ed. Mexico, 1870).

† His frequent references to it show this. See his *Manual de Ministros*, pp. 16, 20, 22, 24, 36, 40, 66, 174, 217, etc. The word *tlecuixtliliztli* is compounded of *tlecuilli*, the hearth or fireplace, and *ixtlilua*, to darken with smoke.

it was scattered upon the flames with a brush, at other times it was poured out around the fireplace."*

28. The high importance of the fire ceremonies in the secret rituals of the modern Mayas is plainly evident from the native Calendars, although their signification has eluded the researches of students, even of the laborious Pio Perez, who was so intimately acquainted with their language and customs. In these Calendars the fire-priest is constantly referred to as *ah-toc*, literally "the fire-master." The rites he celebrates recur at regular intervals of twenty days (the length of one native month) apart. They are four in number. On the first he takes the fire; on the second he kindles the fire; on the third he gives it free play, and on the fourth he extinguishes it. A period of five days is then allowed to elapse, when these ceremonies are recommenced in the same order. Whatever their meaning, they are so important that in the *Buk Xoc*, or General Computation of the Calendar, preserved in the mystic "Books of Chilan Balam," there are special directions for these fire-masters to reckon the proper periods for the exercise of their strange functions.†

29. What, now, was the sentiment which underlay this worship of fire? I think that the facts quoted, and especially the words of Father de Leon, leave no doubt about it. Fire was worshiped as the life-giver, the active generator, of animate existence. This idea was by no means peculiar to them. It repeatedly recurs in Sanskrit, in Greek and in Teutonic mythology, as has been ably pointed out by Dr. Hermann Cohen.‡ The fire-god Agni (*ignis*) is in the Vedas the Maker of men; Prometheus steals the fire from heaven that he may with it animate the human forms he has moulded of clay; even the connection of the pulque with the fire is paralleled in Greek mythos, where Dionysos is called *Pyrigenes*, the "fire-born."

Among the ancient Aztecs the god of fire was called the

* Duran, *Historia de los Indios de la Nueva España*, Tom. ii, p. 240. Sahagun adds that the *octli* was poured on the hearth at four separate points, doubtless the four cardinal points. *Historia de Nueva España*, Lib. i, cap. 13. De la Serna describes the same ceremony as current in his day, *Manual de Ministros*, p. 35. The invocation ran:—"Shining Rose, light-giving Rose, receive and rejoice my heart before the God."

† A copy of these strange "Books of Chilan Balam" is in my possession. I have described them in my *Essays of an Americanist* (Philadelphia, 1890).

‡ See his remarks on "Apperception der Menschenzeugung als Feuerbereitung," in the *Zeitschrift für Völkerpsychologie*, Bd. vi, s. 113, *seq.*

oldest of gods, *Huehueteotl*, and also "Our Father," *Tota*, as it was believed from him all things were derived.* Both among them and the Mayas, as I have pointed out in a previous work, he was supposed to govern the generative proclivities and the sexual relations. † Another of his names was *Xiuhtecutli*, which can be translated "God of the Green Leaf," that is, of vegetable fecundity and productiveness. ‡

To transform themselves into a globe or ball of fire was, as we have seen (antè, p. 29), a power claimed by expert nagualists, and to handle it with impunity, or to blow it from the mouth, was one of their commonest exhibitions. Nothing so much proved their superiority as thus to master this potent element.

30. The same name above referred to, "the Heart of the Town," or "of the Hills," was that which at a comparatively late date was applied to an idol of green stone preserved with religious care in a cavern in the Cerro de Monopostiac, not far from San Francisco del Mar. The spot is still believed by the natives to be enchanted ground and protected by superhuman powers. §

These green stones, called *chalchiuitl*, of jadeite, nephrite, green quartz, or the like, were accounted of peculiar religious significance throughout southern Mexico, and probably to this day many are preserved among the indigenous population as amulets and charms. They were often carved into images, either in human form or representing a frog, the latter apparently the symbol of the waters and of fertility. Bartholomè de Alva refers to them in a passage of his Confessionary. The priest asks the penitent:

"Dost thou possess at this very time little idols of green stone, or frogs made of it (*in chalchiuh coconeme, chalchiuh tamazoltin*)?

"Dost thou put them out in the sun to be warmed? Dost thou keep them wrapped in cotton coverings, with great respect and veneration?

"Dost thou believe, and hold for very truth, that these green stones give thee food and drink, even as thy ancestors believed, who died in their idolatry? Dost thou believe that they give thee success and prosperity

* Sahagun, *Historia de Nueva España*, Lib. i, cap. 13. The Nahuatl text is more definite than the Spanish translation.

† See my *Myths of the New World*, p. 154, *seq.*

‡ In the Nahuatl language the word *xihuitl* (*xiuitl*) has four meanings: a plant, a turquoise, a year and a comet.

§ J. B. Carriedo, *Estudios Historicos del Estado Oaxaqueño*, Tom. i, p. 82, etc.

and good things, and all that thou hast or wishest? Because we know very well that many of you so believe at this very time." *

Down to quite a recent date, and perhaps still, these green stones are employed in certain ceremonies in vogue among the Indians of Oaxaca in order to ensure a plenteous maize harvest. The largest ear of corn in the field is selected and wrapped up in a cloth with some of these chalchiuite. At the next corn-planting it is taken to the field and buried in the soil. This is believed to be a relic of the worship of the ancient Zapotec divinity, Quiegolani, who presided over cultivated fields.†

They are still in use among the natives as lucky stones or amulets. In the Zotzil insurrection of 1869, already referred to, one was found suspended to the neck of one of the slain Indians. It came into the possession of M. Maler, who has described and figured it.‡ It represents a human head with a curious expression and a singular headdress.

From specimens of these amulets preserved in museums it is seen that any greenish stone was selected, preferably those yielding a high, vitreous polish, as jadeite, turquoise, emerald, chlormelanite or precious serpentine. The color gave the sacred character, and this, it seems to me, was distinctly meant to be symbolic of water and its effects, the green of growing plants, and hence of fertility, abundance and prosperity.

31. There is another symbol, still venerated among the present indigenous population, which belongs to Nagualism, and is a survival from the ancient cult; this is the Tree. The species held in especial respect is the ceiba, the silk-cotton tree, the *ytzamatl* (knife-leaved paper tree) of the Nahuas, the *yax che* (green, or first tree) of the Mayas, the *Bombax ceiba* of the botanists. It is of great size and rapid growth. In Southern Mexico and Central America one is to be seen near many of the native villages, and is regarded as in some way the protecting genius of the town.

Sacred trees were familiar to the old Mexican cult, and, what is curious, the same name was applied to such as to the fire,

* Alva, *Confessionario en Lengua Mexicana*, fol. 9.

† Carriedo, *Estudios Historicos*, pp. 6, 7.

‡ In the *Revue d' Ethnographie*, Tom. iii, p. 313. Some very fine objects of this class are described by E. G. Squier, in his "Observations on the Chalchihuitl," in the *Annals of the Lyceum of Natural History*, Vol. i (New York, 1869).

Tota, Our Father. They are said to have represented the gods of woods and waters.* In the ancient mythology we often hear of the "tree of life," represented to have four branches, each sacred to one of the four cardinal points and the divinities associated therewith.

The conventionalized form of this tree in the Mexican figurative paintings strongly resembles a cross. Examples of it are numerous and unmistakable, as, for instance, the cruciform tree of life rising from a head with a protruding tongue, in the Vienna Codex.†

32. Thus, the sign of the cross, either the form with equal arms known as the cross of St. Andrew, which is the oldest Christian form, or the Latin cross, with its arms of unequal length, came to be the ideogram for "life" in the Mexican hieroglyphic writing; and as such, with more or less variants, was employed to signify the *tonalli* or *nagual*, the sign of nativity, the natal day, the personal spirit.‡ The ancient document called the Mappe Quinatzin offers examples, and its meaning is explained by various early writers. The peculiar character of the Mexican ritual calendar, by which nativities were calculated, favored a plan of representing them in the shape of a cross; as we see in the singular *Codex Cruciformis* of the Boturini-Goupil collection.

33. But the doctrines of Nagualism had a phase even more detestable to the missionaries than any of these, an esoteric phase, which brought it into relation to the libidinous cults of Babylon and the orgies of the "Witches' Sabbaths" of the Dark Ages. Of these occult practices we of course have no detailed descriptions, but there are hints and half-glances which leave us in no doubt.

When the mysterious metamorphosis of the individual into his or her *nagual* was about to take place, the person must

* Diego Duran, *Historia de los Indios de Nueva España*, Tom. ii, p. 140.

† In Kingsborough, *Antiquities of Mexico*, Vol. ii, Pl. 180. On the cross as a form derived from a tree see the observations of W. H. Holmes, in the *Second Annual Report of the Bureau of Ethnology*, pp. 270, 271.

‡ "Au Mexique, le cadre croisé, la croix en sautoir, comme celle de St. André, avec quelques variantes, representait le signe de nativité, *tonalli*, la fête, le jour natal." M. Aubin, in Boban, *Catalogue Raisonnée de la Collection Goupil*, Tom. i, p. 227. Both Gomara and Herrera may be quoted to this effect.

strip to absolute nudity;* and the lascivious fury of bands of naked Nagualists, meeting in remote glades by starlight or in the dark recesses of caves, dancing before the statues of the ancient gods, were scenes that stirred the fanaticism of the Spanish missionaries to its highest pitch. Bishop Landa informs us that in Yucatan the dance there known as the *naual* was one of the few in which both men and women took part, and that it "was not very decent." It was afterwards prohibited by the priests. We have excellent authority that such wild rites continued well into the present century, close to the leading cities of the State,† and it is highly likely that they are not unknown to-day.

34. Moreover, it is certain that among the Nagualists, one of their most revered symbols was the *serpent;* in Chiapas, one of their highest orders of the initiated was that of the *chanes*, or serpents. Not only is this in Christian symbolism the form and sign of the Prince of Evil and the enemy of God, but the missionaries were aware that in the astrological symbols of ancient Mexico the serpent represented the *phallus;* that it was regarded as the most potent of all the signs;‡ and modern research has shown, contrary to the opinion long held, that there was among these nations an extraordinary and extensive worship of the reciprocal principle of nature, associated with numerous phallic emblems.§

Huge phalli of stone have been discovered, one, for instance, on the Cerro de las Navajas, not far from the city of Mexico,

* See a curious story from native sources in my *Essays of an Americanist*, pp. 171, 172. It adds that this change can be prevented by casting salt upon the person.

† Benito Maria de Moxo, *Cartas Mejicanas*, p. 257; Landa, *Cosas de Yucatan*, p. 193.

‡ Pedro de los Rios, in his notes to the Codex Vaticanus, published in Kingsborough's great work, assigns the sign, *cohuatl*, the serpent, to "il membro virile, il maggio augurio di tutti gli altri." It is distinctly so shown on the 75th plate of the Codex. De la Serna states that in his day some of the Mexican conjurors used a wand, around which was fastened a living serpent. *Manual de Ministros*, p. 37.

§ There is abundant evidence of this in certain plates of the Codex Troano, and there is also alleged to be much in the Codex Mexicanus of the Palais Bourbon. Writing about the latter, M. Aubin said as far back as 1841—"le culte du lingam on du phallus n'etait pas etranger aux Mexicains, ce qu' etablissent plusieurs documents peu connus et des sculptures découvertes depuis un petit nombre d'années." His letter is in Boban, *Catalogue Raisonné de la Collection Goupil*, Tom. ii, p. 207. On the frequent identification of the serpent symbol with the phallus in classical art, consult Dr. Anton Nagele's article, "Der Schlangen-Cultus," in the *Zeitschrift für Völkerpsychologie*, Band xvii, p. 285, *seq.*

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and another in the State of Hidalgo.* Probably they were used in some such ceremonies as Oviedo describes among the Nahuas of Nicaragua, where the same symbol was represented by conical mounds of earth, around which at certain seasons the women danced with libidinous actions. Although as a general rule the pottery of ancient Mexico avoids obscenity, Brasseur stated that he had seen many specimens of a contrary character from certain regions,† and Dr. Berendt has copied several striking examples, showing curious *yoni* symbols, which are now in my possession.

We may explain these as in some way connected with the worship of Pantecatl, the male divinity who presided over profligate love, and of Tlazolteotl, the *Venus Impudica* of the Aztec pantheon; and it is not without significance that the cave-temple of Votan, whose contents were destroyed by the Bishop of Chiapas, in 1691 (see above, p. 47), was located at *Tlazoaloyan*, both names being derived from a root signifying sexual action.‡ The other name of the divinity, called "the Heart of the Hills," is in Quiche, Alom, "he who begets," and the Zapotec Cozaana, another analogue of the same deity, is translated by Seler, "the Begetter." Such facts indicate how intimately the esoteric doctrines of Nagualism were related to the worship of the reproductive powers of nature.

35. It will readily be understood from what has been said that Nagualism was neither a pure descendant of the ancient cults, nor yet a derivative from Christian doctrines and European superstitions. It was a strange commingling of both, often in grotesque and absurd forms. In fact, the pretended Christianity of the native population of Mexico to-day is little more than a figment, according to the testimony of the most competent observers.§

The rituals and prayers of the nagualists bear witness to this. It is very visible in those I have quoted from Nuñez de

* Cf. G. Tarayre, *Erploration Mineralogique des Regions Mexicaines*, p. 233 (Paris, 1869), and *Bulletin de la Société d'Anthropologie de Paris*, Juin, 1893.

† *Sources de l'Histoire Primitive de Mexique*, p. 81.

‡ From *zo*, to join together. Compare my *Essays of an Americanist*, p. 417 (Philadelphia, 1890).

§ "El indio Mexicano es todavia idolatra." F. Pimentel, *La Situacion actual de la Raza Indigena de Mexico*, p. 197.

la Vega, and I can add an interesting example of it which has not heretofore been published. I take it from the MSS. of Father Vicente Hernandez Spina, cura of Ixtlavacan, in Guatemala, a remote village of the Quiches. He wrote it down in the native tongue about forty years ago, as recited by an *ah-kih*, "reader of days," a native master of the genethliac art, who had composed it in favor of a client who had asked his intercession.

Prayer of an Ah-Kih.

"O Jesus Christ my God: thou God the Son, with the Father and the Holy Spirit, art my only God. To-day, on this day, at this hour, on this day Tihax, I call upon the holy souls which accompany the sun-rising and the sun-setting of the day: with these holy souls I call upon thee, O chief of the genii, thou who dwellest in this mountain of Siba Raxquin: come, ye holy spirits of Juan Vachiac, of Don Domingo Vachiac, of Juan Ixquiaptap, the holy souls of Francisco Excoquich, of Diego Soom, of Juan Fay, of Alonzo Tzep; I call the holy souls of Diego Tziquin and of Don Pedro Noh: you, O priests, to whom all things are revealed, and thou, chief of the genii, you, lords of the mountains, lords of the plains, thou, Don Purupeto Martin, come, accept this incense, accept to-day this candle.*

"Come also, my mother Holy Mary, the Lord of Esquipulas, the Lord of Capetagua, the beloved Mary of Chiantla, with her who dwells at San Lorenzo, and also Mary of Sorrows, Mary Saint Anna, Mary Tibureia, Mary of Carmen, with Saint Michael the Archangel, the captain St. James, St. Christoval, St. Sebastian, St. Nicolas, St. Bonaventura, St. Bernardin, St. Andrew, St. Thomas, St. Bartholomew, and thou my beloved mother St. Catherine, thou beloved Mary of the Conception, Mary of the Rosary, thou lord and king Pascual, be here present.

"And thou, Frost, and thou, excellent Wind, thou, God of the plain, thou, God of Quiac-Basulup, thou, God of Retal-Uleu, thou, lord of San Gregorio, thou, lord of Chii-Masa. [These are mountains and localities, and in the original there follow the names of more than a hundred others. The prayer concludes as follows:]

". . . . I who appoint myself godfather and godmother, I who ask, I the witness and brother of this man who asks, of this man who makes himself your son, O holy souls, I ask, do not let any evil happen unto him, nor let him be unhappy for any cause.

"I the priest, I who speak, I who burn this incense, I who light this candle, I who pray for him, I who take him under my protection, I ask you that he may obtain his subsistence with facility. Thou, God, canst provide him with money; let him not fall ill of fever; I ask that he shall

* The "holy souls" who are here appealed to by name are those of deceased *ah-kih*, or priests of the native cult.

not become paralytic; that he may not choke with severe coughing; that he be not bitten by a serpent; that he become neither bloated nor asthmatic; that he do not go mad; that he be not bitten by a dog; that he be not struck by lightning; that he be not choked with brandy; that he be not killed with iron, nor by a stick, and that he be not carried off by an eagle; guard him, O clouds; aid him, O lightning; aid him, O thunder; aid him, St. Peter; aid him, St. Paul; aid him, eternal Father.

"And I who up to this time have spoken for him to you, I ask you that sickness may visit his enemies. So order it, that when his enemies go forth from their houses, they may meet sickness; order it, that wherever they go, they may meet troubles; do your offices of injury to them, wheresoever they are met; do this that I pray, O holy souls. God be with you; God the Father, God the Son, God the Holy Spirit; Amen, Jesus."

Most of such invocations are expressed in terms far more recondite and symbolic than the above. We have many such preserved in the work of Jacinto de la Serna, which supply ample material to acquaint us with the peculiarities of the sacred and secret language of the nagualists. I shall quote but one, that employed in the curious ceremony of "calling back the *tonal*," referred to on a previous page. I append an explanation of its obscure metaphors.

Invocation for the Restitution of the Tonal.

"Ho there! Come to my aid, mother mine of the skirt of precious stones![1] What keeps thee away, gray ghost, white ghost?[2] Is the obstacle white, or is it yellow? See, I place here the yellow enchantment and the white enchantment.[3]

"I, the Master of the Masters of enchantments, have come, I, who formed thee and gave thee life.[4] Thou, mother mine of the starry skirt, thou, goddess of the stars, who givest life, why hast thou turned against this one?[5]

"Adverse spirit and darkened star, I shall sink thee in the breadth and depth of the waters.[6] I, master of spells, speak to thee Ho there! Mother mine, whose skirt is made of gems, come, seek with me the shining spirit who dwells in the house of light,[7] that we may know what god or mighty power thus destroys and crushes to earth this unfortunate one. Green and black spirit of sickness, leave him and seek thy prey elsewhere.

"Green and yellow ghost, who art wandering, as if lost, over mountains and plains, I seek thee, I desire thee; return to him whom thou hast abandoned. Thou, the nine times beaten, the nine times smitten, see that thou fail me not.[8] Come hither, mother mine, whose robe is of precious

gems; one water, two waters; one rabbit, two rabbits; one deer, two deers; one alligator, two alligators.[9]

"Lo! I myself am here; I am most furious; I make the loudest noise of all; I respect no one; even sticks and stones tremble before me. What god or mighty power dare face me, me, a child of gods and goddesses?[10] I have come to seek and call back the *tonal* of this sick one, wherever it is, whithersoever it has wandered, be it nine times wandered, even unto the nine junctures and the nine unions.[11] Wherever it is, I summon it to return, I order it to return, and to heal and clean this heart and this head."

Explanations.

1. The appeal is to Water, regarded as the universal Mother. The "skirt of precious stones" refers to the green of the precious green stones, a color sacred to water.
2. The question is addressed to the *tonal*.
3. The yellow enchantment is tobacco; the white, a cup of water.
4. That is, assigned the form of the nagual belonging to the sick man.
5. This appeal is directed to the Milky Way.
6. The threat is addressed to the *tonal*, to frighten it into returning.
7. The "shining spirit" is the Fire-god.
8. The yellow tobacco, prepared ceremonially in the manner indicated.
9. These are names of days in the native calendar which are invoked.
10. The priest speaks in the person of his god.
11. Referring to the Nahuatl belief that there are nine upper and nine under worlds.

From the same work of de la Serna I collect the following list of symbolic expressions. It might easily be extended, but these will be sufficient to show the figurative obscurities which they threw around their formulas of conjuration, but which were by no means devoid of coherence and instruction to those who could understand them.

Symbolic Expressions of the Nagualists.

Blood.—"The red woman with snakes on her gown" (referring to the veins).

Copal Gum.—"The white woman" (from the whitish color of the fresh gum).

Cords (for carrying burdens).—"The snake that does woman's work" (because women sit still to knit, and the cord works while itself is carried).

Drunkenness.—"My resting time," or "when I am getting my breath."

The Earth.—"The mirror that smokes" (because of the mists that rise

from it); "the rabbit with its mouth upward" (the rabbit, in opposition to the one they see in the moon; with its mouth upward, because of the mists which rise from it like the breath exhaled from the mouth); "the flower which contains everything" (as all fruit proceeds from flowers, so does all vegetable life proceed from the earth, which is therefore spoken of as a flower); "the flower which bites the mouths" (a flower, for the reason given; it eats the mouths, because all things necessarily return to it, and are swallowed by it).

Fingers.—"The five fates," or "the five works," or "the five fields" (because by the use of his fingers man works out his own destiny. Hence also the worship of the Hand among the Nahuas as the god Maitl, and among the Mayas as the god Kab, both which words mean "hand").

Fire.—"Our Father of the Four Reeds" (because the ceremony of making the new fire was held on the day Four Reeds, 4 Acatl); "the shining rose;" "the yellow flyer;" "the red-haired one;" "the yellow spirit."

A Knife of Copper.—"The yellow Chichimec" (because the Chichimecs were alleged to tear out the bowels of their enemies).

The Maguey Plant.—"My sister, the eight in a row" (because it was planted in this manner).

A Road.—"That which is divided in two, and yet has neither beginning, middle nor end" (because it always lies in two directions from a person, and yet all roads lead into others and thus never end).

Sickness.—"The red woman;" "the breath of the flame;" "our mother the comet" (all referring to the fever); "the Chichimec" (because it aims to destroy life, like these savage warriors); "the spider" (because of its venomous nature).

Smoke.—"The old wife" (*i. e.*, of the fire).

The Sun.—"Our holy and pockified Uncle" (referring to the myth of Nanahuatl, who was syphilitic, and leaping into the flames of a fire rose as the sun).

Tobacco.—"The nine (or seven) times beaten" (because for sacred purposes it was rubbed up this number of times); "the enchanted gray one" (from its color and use in conjuring).

Water.—"The Green Woman" (from the greenness which follows moisture); "our Mother, whose robe is of precious stones" (from the green or vegetable life resembling the turquoise, emerald, jade, etc.).

36. It might be asked how the dark arts and secret ceremonies of the Nagualists escaped the prying eyes of the officers of the Holy Inquisition, which was established in Mexico in 1571. The answer is, that the inquisitors were instructed by Cardinal Diego de Espinosa, who at that time was Inquisitor General and President of the Council of the Indies, "to abstain from proceedings against Indians, because of their stupidity and

incapacity, as well as scant instruction in the Holy Catholic faith, for the crimes of heresy, apostasy, heretical blasphemy, sorcery, incantations, superstitions," etc.

Energetic inquisitors, however, conceded very grudgingly this exemption. In the imposing *auto de fé* celebrated in the city of Mexico, in 1659, a half-breed, Bernardo del Carpio by name, son of a full-blood Indian mother, accused of blasphemy, etc., endeavored to escape the Holy Office by pleading his Indian blood; but his appeal was disallowed, and the precedent established that any admixture whatever of European blood brought the accused within the jurisdiction of the Inquisition.* Even this seems to have been a concession, for we find the record of an *auto de fé* held in 1609, in the province of Tehuantepec, in which eight full-blood natives were punished for worshiping the goddess Pinopiaa.† Mr. David Ferguson, however, who has studied extensively the records of the inquisition in Mexico, informs me that in none of the trials read by him has he observed any charges of Nagualism, although many white persons were accused, and some tried, for consulting Indian sorcerers.

37. It will be seen from what I have said, that the rites of Nagualism extended as widely as did the term over Mexico and Central America. It becomes, therefore, of importance to discover from what linguistic stock this term and its associated words are derived. From that source it is reasonable to suppose the rites of this superstition also had their origin.

The opinions on this subject have been diverse and positive. Most writers have assumed that it is a Nahuatl, or pure Mexican, word; while an eminent authority, Dr. Stoll, is not less certain that it is from a radical belonging to the neighboring great stock of the Mayan dialects, and especially the Quiche, of Guatemala.‡ Perhaps both these positions are erroneous, and we

* See the *Relacion del Auto celebrado en Mexico, año de* 1659 (Mexico, En la Imprenta del Santo Officio, 1659).

† J. B. Carriedo, *Estudios Historicos del Estado Oaxaqueno*, Tom. i, pp 8, 9 (Oaxaca, 1849). About 1610 a number of Indians in the province of Acapulco were put to death for having buried enchanted ashes beneath the floor of a chapel! (Serna, *Manual de Ministros*, p. 52.)

‡ "Nagual ist in seiner correcten Form *naoal* ein echtes Quiché-Wort, ein Substantivum instrumentale, vom Stamme *naó*, wissen, erkennen. *Naoal* ist dasjenige, womit oder woran etwas, in diesem Falle das Schicksal des Kindes, erkannt wird, und hat mit dem mexikanischen *nahualli* (Hexe), mit dem man es vielleicht in Verbindung bringen möchte, nichts zu schaffen." *Guatemala*, s. 238.

must look elsewhere for the true etymology of these expressions. Unquestionably they had become domesticated in both Maya and Nahuatl; but there is some reason to think they were loan-words, belonging to another, and perhaps more venerable, civilization than either of these nations could claim.

To illustrate this I shall subjoin several series of words derived from the same radical which is at the basis of the word nagual, the series, three in number, being taken from the three radically diverse, though geographically contiguous, linguistic stocks, the Maya, the Zapotec and the Nahuatl.

From the Maya, of Yucatan.

Naual, or *nautal*, a native dance, forbidden by the missionaries.
Naatil, talent, skill, ability.
Naat, intelligence, wisdom.
Naatah, to understand, to divine.
Nanaol, to consider, to contemplate, to meditate, to commune with oneself, to enter into oneself.
Noh, great, skillful; as *noh ahceh*, a skillful hunter.

From Maya Dialects.

Quiche-Cakchiquel.

Naual, a witch or sorcerer.
Naualin, to tell fortunes, to predict the future.
Qui naualin, to sacrifice, to offer sacrifices.
Na, to feel, to suspect, to divine, to think in one's heart.
Nao, to know, to be alert or expert in something.
Naol, a skillful person, a rhetorician.
Naotizan, to make another intelligent or astute.
Natal, the memory.
Natub, the soul or shadow of a man.
Noh, the god of reason ("Genius der Vernunft," Scherzer).
Noh, to fecundate, to impregnate (*Popol Vuh*).

Tzental.

X-qna, to know.
X-qnaulai, to know often or thoroughly (frequentative).
Naom, wise, astute (*naom vinic*, hombre sabio).
Naoghi, art, science.
Naoghibal, memory.
Ghnaoghel, a wise man.
Alaghom naom, the Goddess of Wisdom.

From the Zapotec, of Oaxaca.

Nana, gana, gõna, to know.
Nona, to know thoroughly, to retain in the memory.
Nana ticha, or *nona lii,* a wise man.
Guela nana, or *guela nona,* wisdom, knowledge.
Hue gona, or *ro gona,* a teacher, a master.
Na lii, truth ; *ni na lii,* that which is true.
Naciña, or *naciina,* skill, dexterity.
Hui naa, a medicine man, a "nagualist."
Nahaa, to speak pleasantly or agreeably.
Nayaa, or *nayapi,* to speak easily or fluently.
Rigoo gona, to sacrifice, to offer sacrifice.
Ni nana, the understanding, the intelligence, generally.
Nayanii, the superior reason of man.
Nayaa, Naguii, } superiority, a superior man (gentileza, gentil hombre).

From the Nahuatl, of Mexico.

Naua, to dance, holding each other by the hands.
Naualli, a sorcerer, magician, enchanter.
Nauallotl, magic, enchantment, witchcraft.
Nauatl, or *nahuatl,* skillful, astute, smart ; hence, superior ; applied to language, clear, well-sounding, whence (perhaps) the name of the tongue.
Nauati, to speak clearly and distinctly.
Nauatlato, an interpreter.

38. I believe that no one can carefully examine these lists of words, all taken from authorities well acquainted with the several tongues, and writing when they still retained their original purity, without acknowledging that the same radical or syllable underlies them all ; and further, that from the primitive form and rich development of this radical in the Zapotec, it looks as if we must turn to it to recognize the origin of all these expressions, both in the Nahuatl and the Maya linguistic stocks.

The root *na,* to know, is the primitive monosyllabic stem to which we trace all of them. *Nahual* means knowledge, especially mystic knowledge, the Gnosis, the knowledge of the hidden and secret things of nature ; easily enough confounded in uncultivated minds with sorcery and magic.*

* The Abbé Brasseur observes : "Le mot *nahual,* qui vet dire toute science, ou science de tout, est fréquemment employé pour exprimer la sorcellerie chez ces populations." *Bulletin de la Société de Géographie,* 1857, p. 290. In another passage of his works the speculative Abbé translates *naual* by the English "know all," and is not averse to believing that the latter is but a slight variant of the former.

It is very significant that neither the radical *na* nor any of its derivatives are found in the Huasteca dialect of the Mayan tongue, which was spoken about Tampico, far removed from other members of the stock. The inference is that in the southern dialects it was a borrowed stem.

Nor in the Nahuatl language—although its very name is derived from it *—does the radical *na* appear in its simplicity and true significance. To the Nahuas, also, it must have been a loan.

It is true that de la Serna derives the Mexican *naualli*, a sorcerer, from the verb *nahualtia*, to mask or disguise oneself, "because a *naualli* is one who masks or disguises himself under the form of some lower animal, which is his *nagual*;" † but it is altogether likely that *nahualtia* derived its meaning from the custom of the medicine men to wear masks during their ceremonies.

Therefore, if the term *nagual*, and many of its associates and derivatives, were at first borrowed from the Zapotec language, a necessary corrollary of this conclusion is, that along with these terms came most of the superstitions, rites and beliefs to which they allude; which thus became grafted on the general tendency to such superstitions existing everywhere and at all times in the human mind.

Along with the names of the days and the hieroglyphs which mark them, and the complicated arithmetical methods by means of which they were employed, were carried most of the doctrines of the Nagualists, and the name by which they in time became known from central Mexico quite to Nicaragua and beyond.

The mysterious words have now, indeed, lost much of their ancient significance. In a recent dictionary of the Spanish of Mexico *nagual* is defined as "a witch; a word used to frighten children and make them behave," ‡ while in Nicaragua, where the former Nahuatl population has left so many traces of its presence in the language of to-day, the word *nagual* no longer means an actor in the black art, or a knowledge of it, but his or her

* See an article by me, entitled "On the Words 'Anahuac' and 'Nahuatl,'" in the *American Antiquarian*, for November, 1893.

† *Manual de Ministros*, p. 50.

‡ Jesus Sanchez, *Glosario de Voces Castellanas derivadas del Idioma Nahuatl*, sub voce.

armamentarium, or the box, jar or case in which are kept the professional apparatus, the talismans and charms, which constitute the stock in trade or outfit of the necromancer.*

Among the Lacandons, of Mayan stock, who inhabit the forests on the upper waters of the Usumacinta river, at the present day the term *naguate* or *nagutlat* is said to be applied to any one "who is entitled to respect and obedience by age and merit;"† but in all probability he is also believed to possess superior and occult knowledge.

39. All who have any acquaintance with the folk-lore of the world are aware that the notion of men and women having the power to change themselves into beasts is as wide as superstition itself and older than history. It is mentioned in the pages of Herodotus and in the myths of ancient Assyria. It is the property of African negroes, and the peasantry of Europe still hold to their faith in the reality of the were-wolf of Germany, the *loup-garou* of France and the *lupo mannaro* of Italy. Dr. Richard Andrée well says in his interesting study of the subject: "He who would explain the origin of this strange superstition must not approach it as a national or local manifestation, but as one universal in its nature; not as the property of one race or family, but of the species and its psychology at large."‡

Even in such a detail as the direct connection of the name of the person with his power of change do we find extraordinary parallelisms between the superstition of the red man of America and the peasant of Germany. As in Mexico the *nagual* was assigned to the infant by a form of baptism, so in Europe the peasants of east Prussia hold that if the godparent at the time of naming and baptism thinks of a wolf, the infant will acquire the power of becoming one; and in Hesse to pronounce the name of the person in the presence of the animal into which he has been changed will restore him to human shape.§

40. I need not say that the doctrine of personal spirits is not especially Mexican, nor yet American; it belongs to man in

* "*Nagual*—el lugar, rincon, cajon, nambira, etc., donde guarda sus talismanes y trajes de encanta la bruja." Berendt, *La Lengua Castellana de Nicaragua*, MS.

† Emetorio Pineda, *Descripcion Geografica de Chiapas y Soconusco*, p. 23 (Mexico, 1845).

‡ See his article "Wer-wolf," in his *Ethnographische Parallelen und Vergleiche*, p. 62, *seq.*

§ Richard Andrée, *ibid.*, ss. 63, 64.

general, and can be recognized in most religions and many philosophies. In ancient Greece both the Platonicians and later the Neo-Platonicians thought that each individual has a particular spirit, or *daimōn*, in whom is enshrined his or her moral personality. To this *daimōn* he should address his prayers, and should listen heedfully to those interior promptings which seem to arise in the mind from some unseen silent monitor.*

Many a member of the Church of Rome substitutes for the *daimōn* of the Platonists the patron saint after whom he is named, or whom he has chosen from the calendar, the hagiology, of his Church. This analogy did not fail to strike the early missionaries, and they saw in the Indian priest selecting the *nagual* of the child a hideous and diabolical caricature of the holy rites.

But what was their horror when they found that the similarity proceeded so far that the pagan priest also performed a kind of baptismal sacrament with water; and that in the Mexican picture-writing the sign which represents the natal day, the *tonal*, by which the individual demon is denoted, was none other than the sign of the cross, as we have seen. This left no doubt as to the devilish origin of the whole business, which was further supported by the wondrous thaumaturgic powers of its professors.

41. How are we to explain these marvelous statements? It will not do to take the short and easy road of saying they are all lies and frauds. The evidence is too abundant for us to doubt that there was skillful jugglery among the proficients in the occult arts among those nations. They could rival their colleagues in the East Indies and Europe, if not surpass them.

Moreover, is there anything incredible in the reports of the spectators? Are we not familiar with the hypnotic or mesmeric conditions in which the subject sees, hears and feels just what the master tells him to feel and see? The tricks of cutting oneself or others, of swallowing broken glass, of handling venomous reptiles, are well-known performances of the sect of the Aissaoua in northern Africa, and nowadays one does not have to go off the boulevards of Paris to see them repeated. The phenomena of thought transference, of telepathy, of clairvoy-

* See Alfred Maury, *La Magie et l'Astrologie*, pp. 88, 89, 267, etc.

ance, of spiritual rappings, do but reiterate under the clear light of the close of the nineteenth century the mystical thaumaturgy with which these children of nature were familiar centuries ago in the New World, and which are recorded of the theosophists and magicians of Egypt, Greece and Rome.* So long as many intelligent and sensible people among ourselves find all explanations of these modern phenomena inadequate and unsatisfactory, we may patiently wait for a complete solution of those of a greater antiquity.

42. The conclusion to which this study of Nagualism leads is, that it was not merely the belief in a personal guardian spirit, as some have asserted; not merely a survival of fragments of the ancient heathenism, more or less diluted by Christian teachings, as others have maintained; but that above and beyond these, it was a powerful secret organization, extending over a wide area, including members of different languages and varying culture, bound together by mystic rites, by necromantic powers and occult doctrines; but, more than all, by one intense emotion—hatred of the whites—and by one unalterable purpose—that of their destruction, and with them the annihilation of the government and religion which they had introduced.

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* In the *Notice Preliminaire* to the second part of his work, *La Magie et l'Astrologie dans l'Antiquité et au Moyen Age*, Mr. Alfred Maury admirably sums up the scientific resources at our command for explaining the mystical phenomena of experience, without denying their reality as actual occurrences.

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The Yolk Nucleus in Cymatogaster aggregatus Gibbons.

*By Jesse W. Hubbard.**

(*Read before the American Philosophical Society, December 15, 1893.*)

The so called yolk nucleus is a compact, irregular mass of granules found in the yolk of the eggs of certain animals. It lies outside the germinal vesicle and usually takes a deep stain similar to the nucleolus within the germinal vesicle.

It has been seen in the eggs of Cnidarians (Häcker and others), Nematodes (Monticelli), Sagitta (Hertwig), Crustaceans (Weismann and others), Myriopods (Ludwig), Insects (Balbiani), Arachnids (Carus, Ludwig and others), Lamellibranchs (Ihering), Gastropods (Balbiani), Teleosteans (Van Bambeke), Batrachians (Cramer, Carus and others), Reptiles (Eimer), Aves (Cramer and others), Mammals (Schäfer). It is probably a normal structure of fish eggs, but on account of unfavorable conditions its complete history has not been traced in any species.

The problem we wish to solve is: (1) How does this body originate, (2) what becomes of it, (3) what function has it in the egg? There are many difficulties to the solution of the problem by ordinary fish eggs. Their great size, complexity of structure owing to accumulation of yolk, close proximity to each other and liability to crumble in sectioning—all are a detriment to its study.

Cymatogaster has in these respects many advantages over all others. (1) The eggs of this genus are the smallest of fish eggs, hence a few sections show the entire egg. The eggs of Cymatogaster reach a maximum size of .3 mm. in diameter; while other fish eggs average about 1 mm. in diameter. (2) There are comparatively few eggs in each ovary, so they are not distorted by crowding. (3) In their natural state, if uninjured by reagents, they are perfectly spherical and thus admit of easy measurement. (4) There is but little yolk when ripe and hence they may be sectioned without crumbling. (5) The nucleus seldom contains many nucleoli. It generally has but one distinct nucleolar spot. In very young eggs, and those about ripe, a few others may be seen, not more than four or five. (6) The last and most important advantage these eggs possess is the fact that the yolk nucleus is conspicuous from the time the eggs have reached a diameter of 20 μ until maturation and even beyond that to the closing of the blastopore!

The observations were made on ovaries collected by Dr. Carl Eigenmann on the coast of California. They represent individuals from 17 mm. to 140 mm. in length and were preserved chiefly in June, July and August and in October, November, December, January and February. Most of them were preserved in Flemming's strong mixture of osmic-

* Contributions from the Zoölogical Laboratory of the Indiana University, under the direction of Carl Eigenmann, iii.

chromic-acetic. A few others in platinum chloride and corrosive sublimate. Those killed in the two last mentioned were not very favorable for the study of the yolk nucleus. Some of the ovaries were stained in toto by hæmatoxylin. Others were stained on the slide by eosin. This is an excellent stain for eggs near maturity. The former was the better for younger eggs. After clearing with clove oil and infiltration in paraffin they were cut and mounted in Canada Balsam.

I made a number of experiments with different staining media. Neither mythyl green, mythyl violet, dahlia or safrinin sufficiently differentiated the tissues and the body I wished to trace. I found, however, that mythyl violet did not stain anything in the ovary, but did stain the outside muscular tissue and the spermatazoans contained in the ovary, the latter being stained a bright violet. Using alcoholic eosin and methyl violet as a double stain rendered all the tissues red except the spermatozoöns, which were a bright violet.

I have examined the ovaries of very small fish measuring 17 mm., 29 mm., 35 mm. and 40 mm. in length. In none of the largest eggs of these did I find any trace of a yolk nucleus. In a fish 45 mm. long I found a few eggs which seemed to have this body, but not at all distinct, as the ovary was not well preserved. The adult fish reaches a length 140 mm. In a fish 70 mm. long I found this body quite distinct. So it must appear in the egg when the fish is between 40 mm. and 70 mm. in length. But, as I had no specimens between these two sizes, I cannot definitely determine just when it appears in the egg.

In the young, 40 mm. and less in length, the largest eggs measure 35 μ, 30 μ, 25 μ. In none of these eggs was the body visible in the protoplasm of the egg. But eggs about the same size as above found in an ovary of an adult fish showed clearly the presence of this body. This early stage was not seen in all the ovaries sectioned. The one in which it was seen was taken October 21, killed in osmic-chromic acetic, stained in hæmatoxylin, cleared with clove oil and mounted in Canada Balsam. The smallest egg in which the yolk nucleus was observed was 20 μ in diameter, *i. e.*, it was smaller than the largest egg in the ovary of the small fish 40 mm. in length, in which the yolk nucleus had not appeared. In these eggs of the adult fish the protoplasm around one side of the nucleus takes a deep stain. It appears as a crescent-shaped body, fitting very closely to one side of the nucleus and forming a kind of cap (Fig. 1, yk. nl.). Another egg of the same measurement shows a little more advanced stage. The body is more definite in shape, not of so pronounced a crescent form and appears to have enlarged considerably (Fig. 2, yk. nl.). The next important change is seen in a slightly larger egg, 25 μ in diameter (Fig. 3, yk. nl.). Here the body has assumed an oval form without any definite cell wall or hard outline. Although usually touching the nucleus it seems to have no further connection with it. In this egg it is quite large, measuring 10 μ in minor axis and 12½ μ in major axis. From this time the body seems to have severed its connection with

the nucleus, and during the remainder of the egg's immaturity gradually moves away from the nucleus. From this fact and its early relation to the nucleus it seems evident that it must have originated from the nucleus. But there is another more potent proof that this is its origin. The largest eggs in the young fishes 17 mm., 29 mm., 35 mm. and 40 mm. in length measured as follows:

Diameter of egg	35 μ.	Diameter of nucleus	20 μ.
" "	30 μ.	" "	$17\frac{1}{2}$ μ.
" "	25 μ.	" "	15 μ.

In other words, the diameter of the nucleus is more than half the diameter of the egg. It will be remembered that none of these eggs contained a yolk nucleus. The smallest eggs in the adult fish containing a yolk nucleus measured as follows:

Diameter of egg	20 μ.	Diameter of nucleus	10 μ.
" "	25 μ.	" "	$12\frac{1}{2}$ μ.
" "	30 μ.	" "	15 μ.

That is, the nucleus has now been reduced to a diameter equal to one-half that of the egg. If this body originates from the nucleus as an extrusion of a part of its substance we should expect the nucleus to be relatively larger to the size of the egg before it appears than after its appearance. This is exactly the case in these eggs (compare nucleus in Fig. 1a and Fig. 3). It will be seen from the two sets of measurements given above that in the eggs in which this body is not visible the diameter of the nucleus is always *more than half* that of the egg, while in the eggs in which it is visible the diameter is *just half* that of the egg. This relation is true in all the measurements I made.

Take an egg with a diameter of 25 μ as a typical size of the smallest eggs in the adult fish and the largest in the small fish. To simplify operations I have taken the number of divisions of the mikrometer instead of the absolute measurement of the egg. Then the sizes of the eggs are expressed as follows:

Diam. of egg in adult fish .....(s) 5.		Diam. of nucleus	$2\frac{1}{2}$.
" " small " ....(o) 5.		" "	3.

The dark body (e) in the protoplasm of the egg being an oblate spheroid measures 2 in conjugate axis and 2.375 in tranverse axis.

Now the solid contents of the nucleus in o ought to equal the solid contents of the nucleus s, plus the solid contents of the dark body e, or $o = s + e$.

Formula for contents of a sphere is $\vee = \frac{1}{6} \pi D^3$.
" " " " oblate spheroid is $\vee = \frac{4}{3} \pi a^2 b$.

$\vee$ = volume.
D = diameter.
a = semi-transverse axis.
b = semi-conjugate axis.

Substituting values in the formula for the sphere $\sqrt{}$ of the nucleus of egg $o = 14.1372$. $\sqrt{}$ of the nucleus of egg $s = 8.18125$. $\sqrt{}$ of the dark body e (or the oblate spheroid) $= 5.90704+$. Therefore o $(14.1372) = s$ $(8.1825) + e$ $(5.9070+)$, leaving an error of only .049, which amounts to very little when considering that each division of the mikrometer only equals .005 mm. and that the outlines of the dark body not being very definite it was difficult to get the precise measurement.

I think this clearly proves that the body originates from the nucleus. But I do not believe it is by ordinary cell division with the formation of a karyokinetic figure. It seems to be a general extrusion of substance from the nucleus.

It will be seen from an inspection of Figs. 4–12 that this body is considerably smaller in these stages than in smaller eggs (Fig. 3). Whether this is due to reagents causing a shrinkage or whether due to a condensation of substance I am unable to determine. After the egg is 40 μ in size (Fig. 5), at which time the body has reached its minimum size, it continues to constantly increase through all of the other sizes. It is nearly always irregular in shape and very seldom has a hard outline which might represent a cell wall.

Sometimes it assumes very peculiar shapes (see Figs. 7, 9, 10, 13). The most aberrant form is represented in Fig. 9, where it seems to have a long filament or tail, which is only seen by careful focusing.

Cymatogaster is viviparous. The eggs of this fish ripen during the months of December, January and February. In an ovary taken on October 21 they range in size from .02 mm. to .2 mm. The eggs of November 2 begin to show signs of ripening (Fig. 17 (a)). Here the nucleus is a little eccentric. The zona radiata is quite distinct and the follicle is well formed. At this stage of maturity there is a peculiar circular region shaded much more darkly than the remainder of the vitellus. This always appears on the side of the nucleus next to the yolk nucleus and opposite the point of the egg to which the nucleus seems to be moving. The yolk nucleus under consideration is quite close to the periphery of the egg.

November 30 some of the eggs become about ripe. Fig. 18 represents one which will probably be ripe in January. In this egg the follicle is much developed, the nucleus has become very eccentric and the yolk nucleus is nearly touching the periphery of the egg. Up to this time the constant tendency of this body has been to become further and further removed from the nucleus towards the periphery of the egg.

In the stages indicated by Figs. 19 and 20* the body has become slightly changed in appearance. These eggs are nearly ripe. The nucleus has reached its limit of eccentricity, and in one stage (Fig. 20) has lost its cell wall. I have merely indicated its position, which is seen in another section. The yolk is beginning to collect at the entodermic pole of the egg, *i. e.*, around the yolk nucleus.

* These and succeeding figures are based on preparations made by Dr. Eigenmann.

In the ripe egg (Fig. 21) the body in question is found surrounded by the yolk. This egg was in the act of giving off the second polar globule. The latter is not figured because seen in another section.

After the egg is matured this body assumes many curious and interesting shapes (Figs. 21–26). In Fig. 21 the yolk nucleus seems to have broken into large granules, several of them being grouped into a dark mass (yk. nl.). The whole region including the granules is somewhat shaded.

After the egg has segmented into two cells, the appearance is nearly the same as that just described, except the granules are not quite so large and prominent (Fig. 22). To this time the yolk nucleus has shown a granular structure, but as I have represented in the remaining figures it looses that structure and appears to be homogeneous.

In the stage represented in Fig. 23 this yolk nucleus has entirely changed its appearance. I did not have the sections to show the intermediate stages. At this time the egg has segmented into 32–64 cells. The yolk nucleus and its vicinity shows four different degrees of shading. The centre of what seems to be the yolk nucleus proper is of a lighter shade than the margin which is quite dark. Outside of this there is a still lighter shade than that within the body. Beyond the last is another still less distinct.

When the egg has segmented into many cells, perhaps 600 (Fig. 24), the yolk nucleus is larger and shows only one distinct shading.

Fig. 25 shows the greatest peculiarity of any. Here the blastopore is nearly closed. The body in question is somewhat pear-shaped and has a few small vacuoles scattered through it. It does not have such a distinctly granular structure, but is of a uniformly dark shade. It seems to form a kind of plug to the blastopore. The lower edge of this body is marked by a distinct outline, but the upper edge does not have such an outline. For a considerable region in its vicinity there are different degrees of shading. Also near the upper side there is a heavy shading which seems to consist of minute granules.

After the closing of the blastopore (Fig. 25) the yolk nucleus is much reduced in size, the shadings have disappeared and there is seen only a number of granules. The yolk also contains several similar granules scattered through it. Here it seems evident the yolk nucleus has reached the final stage of disintegration. It does not appear in any of the later stages of development. I think that the different appearances this body presents after segmentation of the egg begins are due to the fact that it is in the process of disintegration. The different depths of shading probably indicate the scattering of its substance through the yolk.

This body seems always to be situated at or nearer the entodermic end of the pole of the egg. Its position is constant during all its stages of growth. It may be utilized in determining whether the axis of the egg has any definite and uniform relation to the axis of the ovary. A compari-

son of the axis of eggs as determined by the position of the yolk nucleus shows that the axis of the egg has no uniform relation to the axis of the ovary.

Summary.

1. This body originates from the nucleus in very small eggs in the adult; soon after the cell becomes fully differentiated as an egg.

2. It constantly moves from the nucleus towards the entodermic pole of the egg which it reaches when the egg is ripe.

3. It is situated at the entodermic pole of the egg at maturity and during later stages.

4. It is capable of growth condensing apparently when very young and then continuing to grow to considerable size.

5. It is of definite chemical composition, having great affinity for certain stains.

6. It remains in the egg until the closing of the blastopore and then breaks up and disappears in the yolk.

7. It is found in the eggs of many animals and has been figured as belonging to the spermatogonium or male cell. See especially *Zeit. für Wissen. Zool.*, Vol. li, Taf. xxxvi; also *Arkiv. für Mikro. Anat.*, Vol. xxxix, Taf. xxi.

The majority of papers on embryology which mention this body dismiss it without much comment. However, there are a few writers who attempt to explain its function in other animals. The consensus of opinion seems to be that it is the centre of yolk formation. But there is no direct evidence that such is the case. It is mere speculation from the fact that it is found in the protoplasm of the egg, before the yolk is formed. In the eggs of Cymatogaster I have never seen any evidence that it gives rise to the yolk. The yolk globules are scattered through the protoplasm, seeming to appear equally in all parts of the egg. As the yolk gradually forms it is homogeneously distributed in different sectors of the egg until maturation. Then the yolk collects at the entodermic pole of the egg, where the yolk nucleus has become located long before.

The close association which this body has with the yolk would seem to indicate that it is in some way connected with it. But how? I think in many of the eggs in which this body has been seen it is not at all functional. But from the length of time it remains in the eggs of Cymatogaster and from the wonderful changes it undergoes in growth it would seem to be functional in this egg. Dr. Eigenmann has shown that these eggs mature very rapidly and hence have a small amount of yolk. This fact may account for the yolk nucleus remaining so long after segmentation begins. If the egg matured very slowly and allowed the formation of a large amount of yolk this body would probably disappear before the egg is ripe, as it does in other fishes.

Another interesting question arises as to what determines its position

exactly at the entodermic pole of the egg. It seems to tend to that definite position when it first leaves the nucleus. But without any question it takes up its station there before the nucleus begins to move towards the periphery of the egg, as the nucleus always moves in a directly opposite direction from the body. In all eggs the yolk collects at the entodermic pole of the egg. Does this peculiar body serve as an attraction for the yolk in this egg? Or is it a mere coincidence that it is in the midst of the yolk and has no particular connection with it?

In conclusion, I would say that I cannot definitely determine its function. I think the body is homologous with the meganucleus in protozoans. It is the vegetative portion of the egg given off from the nucleus when the egg cell has become fully differentiated as such. That which remains of the nucleus is homologous with the micronucleus in protozoans. It is the animal part of the egg which is further concerned wholly with the reproduction of the species.

Historical Review of the Literature on the Yolk Nucleus.

Hoffman ('78, p. 545) in his studies on the young ovarian eggs of amphibians saw the yolk nucleus in *Rana esculentia*. He merely mentions it and describes it as a round, dark, granular body within the yolk. He says it is not seen in all amphibians.

Balbiani ('79) has had some very peculiar views on the origin of this body. His ideas being now so untenable, I quote this more as a curiosity than as shedding any light on the true origin. He considers the follicular cells as homologous to the spermatoblasts. The yolk nucleus corresponds to the spermatic elements. One, becoming free from the follicle, penetrates the yolk. When it first enters it leaves a sort of canal behind it, which is soon closed up by the surrounding yolk. It is a sort of spermatozoid and partially fertilizes the egg preliminary to the true fertilization which takes place later. In parthenogenetic eggs this body would perform the function of the male element. If his descriptions are based on facts the body he described is not homologous with the yolk nucleus of authors in general.

Schäfer ('80) describes and figures this body in the eggs of the rabbit. He thinks he saw some connection between the nucleus and the yolk nucleus. He believes that the latter is derived from the former, but not by a process of ordinary cell division.

Schütz ('82) has given an extended review of this body as seen in various classes of animals. But he seems to have no adequate conception either of its origin, function or fate. He remarks that the yolk may have produced it and that it later serves as nutrition for the yolk. The observations were made on isolated specimens of fresh eggs. No sections were made nor was the body traced out in any single species. He has, however, carefully compiled a large list of animals in which it has been seen, and has described its structure and appearance in many of them. His refer-

ences to the literature on the subject is extensive, but, much of it being inaccessible to me, I have made no note of what I could not personally examine.

Van Bambeke ('83) studied this body in the eggs of *Luciscus rutilus* and *Rhodeus amarus*. He says very little as to its origin, but thinks it may come from the nucleus. His figures show it to be connected with the nucleus by a funnel-shaped tube, the large end of which encloses the nucleus and the small end touches the yolk nucleus. From this appearance it would seem to be connected in some way with the nucleus. He seems to think this body is the centre of the yolk elements.

Balbiani ('83, p. 676) found this body in the eggs of *Geophiles*. In these eggs the nucleus sends out prolongations. These break off close to the nucleus and in turn they break up into large granules. These take a deep stain. These granules, he thought afterwards, left the vitellus and became the cells of the follicle. In this theory he was supported by Fol, Roule and Sabatier. There was one granule, however, that became differentiated from the others, and instead of forming a cell of the follicle remained in the vitellus and became what is known as the yolk nucleus. He thought its function was to originate the yolk. He says: "The first granulations of yolk are produced on the surface of this body and afterwards distribute themselves to all parts of the egg." In some animals he finds lines radiating in all directions from this body. Forming the limit to these radiating lines are concentric layers of substance.

Balfour ('85, pp. 21, 50) describes the yolk nucleus as seen in *Araneina* by Ludwig and others. He says it always disappears before development commences. He remarks that it is probably connected in some way with the nutrition of the ovum. This body is not found in all genera of *Araneina*.

Haeker ('92, p. 251) having studied this body in *Aequorea forskalea* calls it the metanucleolus. In the ovarian eggs it was present within the nucleus as the nucleolus. One half hour after being laid the nucleus appeared to extrude this body. He traced the body in the blastomeres until a late stage in cleavage. The author thinks homologous structures have been seen in other Medusæ. He considers the paracopulation cells of Daphnids described by Weismann and Ishikawa as homologous with the metanucleus of Medusæ. Haeker did not observe any division or any radial arrangement of protoplasm around this body.

Monticelli ('92) has studied this structure in the ova of *Distomum veliporum* and *D. richicardi*. He concludes that the vitelline nucleus is a cytoplasmic product, a nutritive differentiation probably acting as a centre in the formation of yolk.

Bibliography.

Papers of which I have only seen an abstract are marked with an asterisk.

Balbiani, E. G.: '64.* Sur la constitution du germs dans l'œuf animal avant la fécondation. Comptes rendus, lviii, pp. 584–588, 621–625.

'79.* Léçons sur le génération de Vertébrés. Paris.

'83. Sur l'origine des cellules du follicle et du noyan vitellin de l'œuf chez les Geophiles. Carus, Zool. Anz., vii. Jahrgang, Dec., pp. 676–678. Leipzig.

Balfour, Francis M.: '85. Comparative Embryology. Vol. i, pp. 20, 51. London, Macmillan & Co.

Carus: '50. * Ueber die Entwickelung des Spinneneies. Siebold's & Kolliker's Zeit. für Wissen. Zool. Leipzig.

Cramer: '48. * Bemerkung über das Zellenleben in der Entwickelung des froscheies. Müller's Archiv. für Anat. Phys. und Wissen. Med.

Eigenmann, Carl: '89. American Naturalist, Oct., 1889, p. 924.

'92. Viviparous Fishes of the West Coast of North America. Report of the U. S. Fish Commission.

Goette, Alexander: '75. Entwickelungsgeschichte der Unke. Leipzig.

Hoffman, C. K.: '78. Entwickelung und Bau des Eierstockeies (Amphibien). Klassen und Ordnungen des Thierreichs, vi. Bd., 2. Abtheilung, p. 545.

Haeker, V.: '92. Die Furchung des Eis von Aequorea forskalea—Der metanucleolus. Arkiv. für Mik. Anat., 40. Bd., Sept., 1892, p. 251, Taf. xiii, xiv.

Hertwig, O.: '78. Beitr. zur Kenntniss der Bildung, Befruchtung, und Theilung des thierischen Eis. Morph. Jahrb., 4. Bd., 1878.

Kraemer, Adolph: '92. Beiträge zur Anatomie und Histologie der Cestoden der süsswasser Fische. Zeit. für Wissen. Zool., 53 Bd., Fig. 27, Taf. xxviii, pp. 693, 712.

Ludwig, Hubert: '74. Ueber die Eibildung im Thierreiche. Pp. 117, 120. Würzburg, 1874.

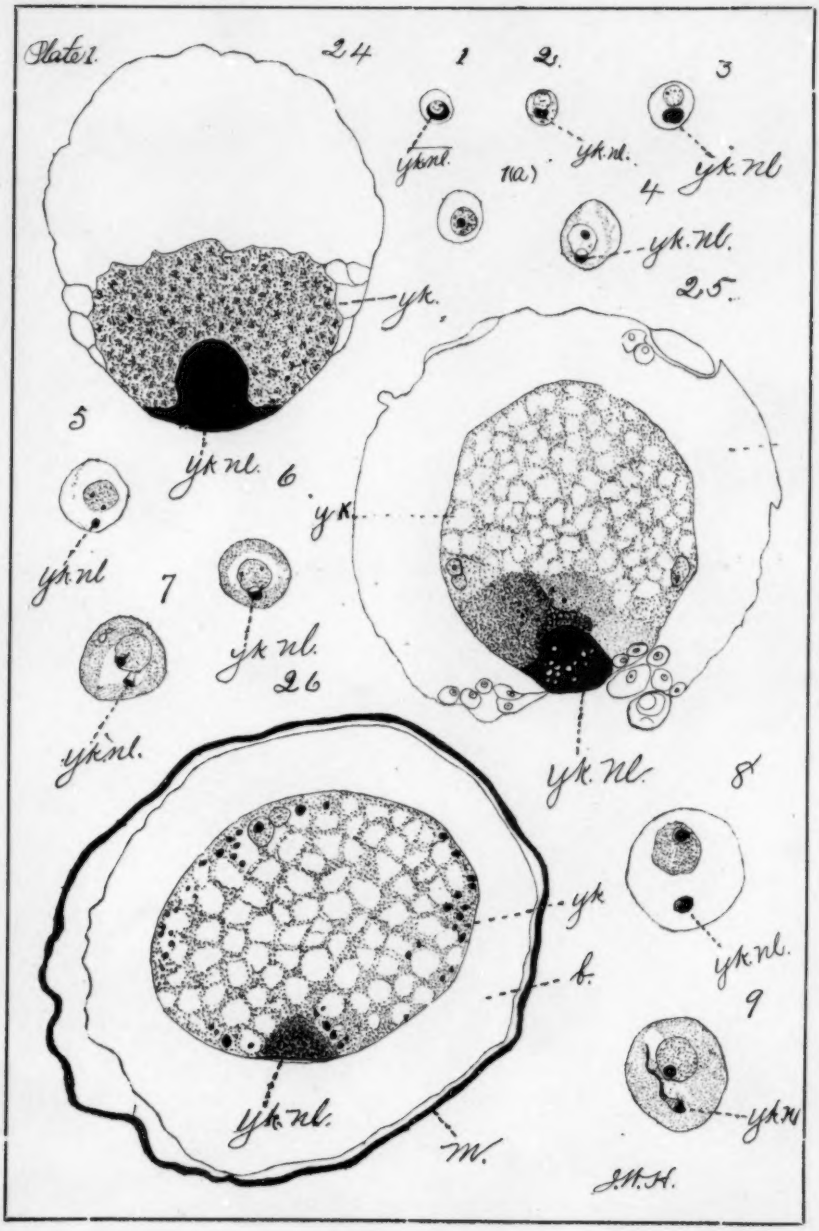
Leukart: '53. * Abstract in "Die Entwickelungsgeschichte der Unke." By Alexander Goette. P. 7. Leipzig, 1875.

Monticelli, F. S.: '92. * Vitelline nucleus in ova of Trematodes. Journ. Royal Micro. Society, Oct., 1892, p. 618. London.

Oppel, Albert: '92. Die Befruchtung des Reptilieneies. Arkiv. für Mikro. Anat., 39. Bd., pp. 264–286, Figs. 14, 18, 20, 25, 28, 31, 32, Taf. ix, x.

Rückert, J.: '92. * Polyspermy in Vertebrates. Amer. Nat., Nov., 1892. P. 967.

Schäfer, E. A.: '80. * On the Structure of the Immature Ovum in the Common Fowl and the Rabbit. Pro. Roy. Soc., No. 202, 1880, p. 243, Pl. iii, Fig. 18. London.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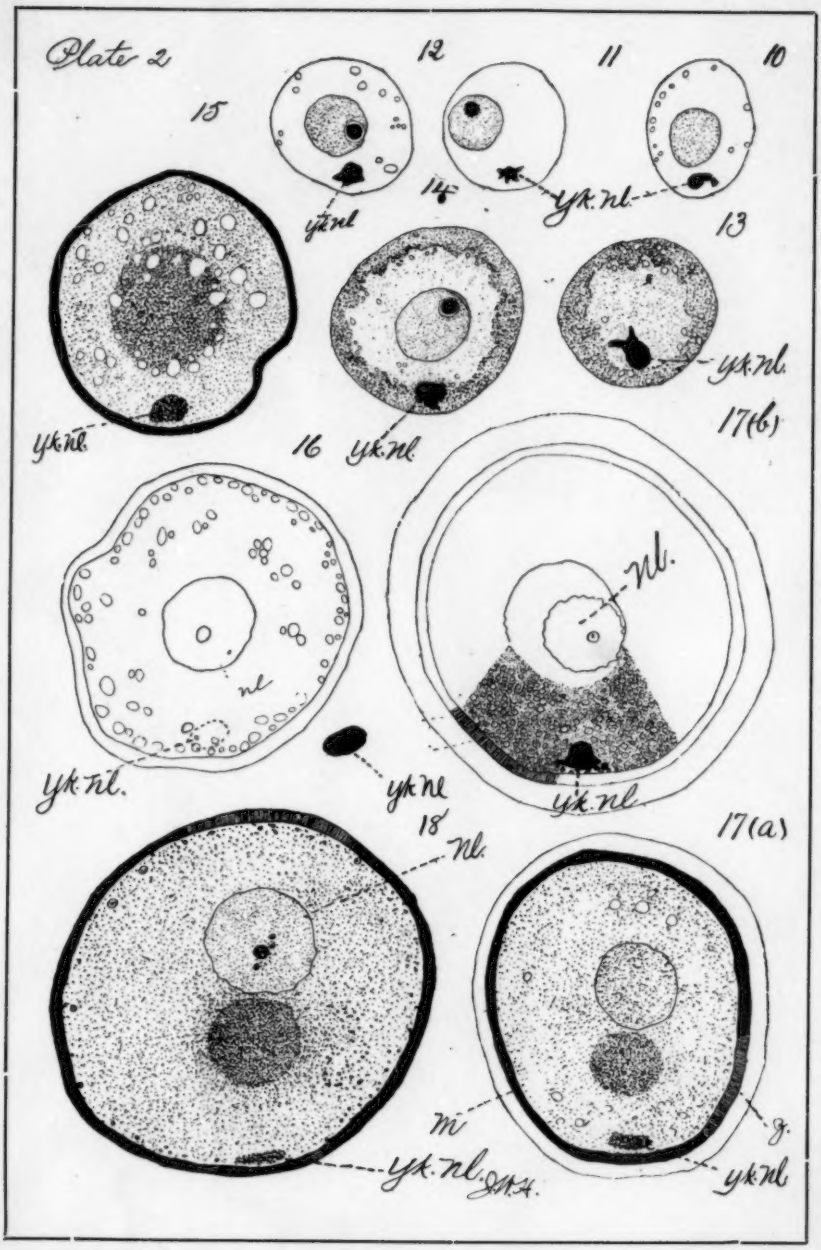
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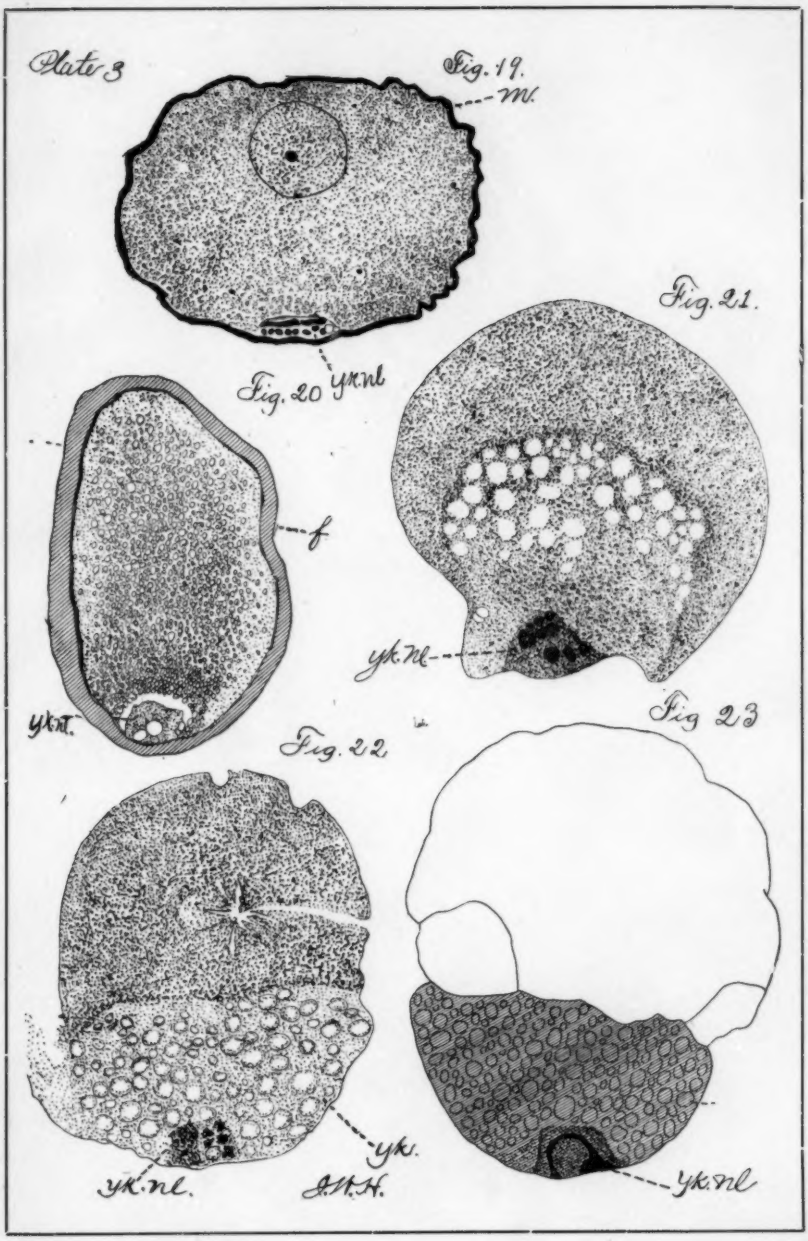
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St. George, Valette: '92. Ueber innere Zwitterbildung beim Flusskrebs. Arkiv. für Mikro. Anat., Vol. xxxix, Taf. xxi.

Schütz, Joseph: '82. Ueber den Dotterkern, dessen Entstehung, Structur, Vorkommen, und Bedeutung. Bonn, 1832.

Thompson: '59. *Abstract in "Die Entwick. der Unke." By Alexander Goette. P. 8. Leipzig.

Van Bambeke, C. H.: '70. *Abstract in "Die Entwick. der Unke." By Alexander Goette. P. 9. Leipzig.

'83. Contributions à l'histoire de la constitution de l'œuf. Brussels, 1883. Extrait du Bulletin de l'Académie royale des sciences de Belgique. 52 année, 3 serie, tome vi, No. 12.

Zeller, Ernst: '91. Berichtigung, betreffend die Samenaufnahme der weiblichen Tritonen. Zeit. für Wissen. Zool., Vol. li, Taf. xxxvi.

Explanation of Figures.

Abbreviations.

b—blastoderm.
f—follicle.
m—egg membrane = zona radiata.
nl—nucleus.
yk—yolk.
z—zona radiata.
yk. nl.—yolk nucleus.

All the figures were drawn with the Abbe camera and Zeiss D and 4 μ, x 320.

Figs. 1–9 and 24–26, inclusive, are found on Plate i.
" 10–18, inclusive, are found on Plate ii.
" 19–23, " " " " iii.

Fig. 1. First appearance of yolk nucleus in smallest eggs.
" 1(*a*). Nucleus before extrusion of yolk nucleus.
" 2, 3. Successive stages of growth.
" 4. Yolk nucleus much reduced in size.
" 5–16. Successive changes in appearance and growth of the yolk nucleus.
(All of the above eggs stained in hæmatoxylin.)
" 17(*a*), 18. Stained in eosin.
" 19. Egg near the time of maturation.
Fig. 20. A little latter stage than that of Fig. 19.
" 21. A ripe egg. Yolk collected at entodermic pole of the egg.
" 22. Egg segmented into 2 cells.
" 23. " " " 32–64 cells.
" 24. " " " many cells, probably 600.
" 25. Late stage in segmentation. Blastopore nearly closed.
" 26. Blastopore closed. Yolk nucleus somewhat scattered through the yolk.

On the Fishes obtained by the Naturalist Expedition in Rio Grande do Sul.

By E. D. Cope.

(*Read before the American Philosophical Society, January 5, 1894.*)

The fishes of the Brazilian province of Rio Grande do Sul have been locally studied by Hensel (1868–70) and Von Jhring (1893), so that they are better known than those of some other parts of South America. The latest enumeration, that of Von Jhring, includes forty-nine species. The present report includes forty-one species, of which twenty are not found in Von Jhring's list. Perhaps three of these are enumerated by that author under different names, so that this paper adds perhaps seventeen species, bringing the whole number to sixty-six species. The number of species in Von Jhring's list which I have not found in this collection is thirty. This wide diversity in the collections is probably due to the fact that those studied by Hensel and Von Jhring were made much nearer the coast, while my collection was obtained in the interior near the mountains. The absence of various species of the lower and tide waters from my collection, together with the presence of species of the smaller streams, may be thus accounted for. A summary of the results will be given at the end of the paper.

The collection now reported on was made by Mr. H. H. Smith, who was sent to Brazil in the interest of the *American Naturalist*. A report on the Mammals was made in that periodical in the year 1889; and reports on the Reptiles and Batrachia have been published in the *Proceedings* of this Society for 1884 and 1887.

PLECTOSPONDYLI.

Characinidæ.

Macrodon tareira Bl. and Schn.

Authors who think, with the American Ornithologists' Union, that scientific nomenclature may record error instead of truth, call this well-known South American species, *Macrodon malabaricus*, because Bloch described it first under that name, under the mistaken idea that it was a native of India.

Xiphorhamphus brachycephalus sp. nov.

Teeth of the maxillary bone small, equal. Head short, body deep, scales large. Depth of body entering length without caudal fin, three times; length of head in the same four times. Scales $\frac{10}{51}$. Fin $\frac{6}{}$ radii, D. 11; A. 27. Muzzle short, entering length of head 3.5 times; diameter of eye entering the same four times; interorbital space convex, its width entering length of head 3.5 times, hence equal length of muzzle. The profile is slightly descending and nearly straight. The

extremity of the maxillary bone is in line with the posterior border of the orbit. The pectoral fin reaches the base of the ventral, but the ventral does not quite reach the anal.

The color is silver, with greenish and bluish reflections. A large black spot at the base of the caudal, and a smaller one behind the epiclavicle. No lateral band.

Total length, 177 mm.; length to base of caudal fin, 145 mm.; length to base of anal, 89 mm.; length to base of ventral, 63 mm.; length of head, 37 mm.

This species is near the *X. hepsetus* Cuv. From the full description and figures given by Steindachner,* we learn that in that species, both the body and head are of more slender proportions at all ages, and that the interorbital diameter is relatively narrower. It possesses also a silver lateral band which terminates in a black stripe on the caudal peduncle and fin. The scale and ray formulæ are the same in the two species.

The *X. jenynsii* Gthr. was thought by Steindachner to be identical with the *X. hepsetus*, but he subsequently concluded that it is distinct (see *Sitzber. Wien Akad.*, 1891, p. 371). It is evidently very near the latter, and has a more slender form of head and body than the *X. brachycephalus*. The depth enters the length, according to Steindachner, 3.3 to 3.5 times; and the length of head enters the length 3.5 to 3.6 times. The interorbital width is less, entering the length of the head 4 to 4.5 times. Scales of lateral line 56–62.

Two specimens.

XIPHORHAMPHUS HEPSETUS Cuv. Steind., *l. c.*

Two specimens. The smaller measuring 179 mm., agrees with Steindachner's description, but the larger, 215 mm., differs in exceeding the proportions given as characteristic of old individuals. Thus the scale formula is $\frac{17}{76}$; the highest figures given by Steindachner being $\frac{14}{70}$. The eye enters the total length of the head 5.5 times; the highest relative proportions of Steindachner's description being 4.66 times. In both specimens the length of the head exceeds the depth of the body.

ASIPHONICHTHYS STENOPTERUS Cope, *Amer. Naturalist*, 1894, p. 67.

Char. gen.—Subfamily Hydrocyoninæ. Teeth on premaxillary, maxillary and dentary bones; the first in two series, the last in one; those of both of unequal lengths. Dorsal fin short, above the anterior rays of the long anal. No lateral line of pores, except on a few anterior scales. Gill-rakers lanceolate.

This genus is Anacyrtus without a lateral line of pores.

Char. specif.—Dorsal outline elevated; profile of cranium concave; mouth directed obliquely upwards. Scales 42, 20. Fin radii, D. 11; A. 46, the anterior three shorter; V. 9; P. 15. Depth of body 2.66 times in

* *Sitzungsber. K. Wien Akad. Wiss.*, Nov., 1876, p. 35.

length without caudal fin. Length of head 3.8 times in the same. Eye three times in head; exceeding length of muzzle and equal interorbital width. Dorsal fin elevated, narrow; pectorals narrow, covering basal third of ventrals; ventrals lanciform, reaching fourth anal ray. Color silvery, with an ill-defined silver lateral band. An obscure postclavicular dark spot, and some obscure dark dots on the silver lateral band. No basal caudal spot.

Length to end of middle caudle radii, 80 mm.; length to base of caudal fin, 72 mm.; length to base of anal (oblique) 35 mm.; length to base of ventrals, 26 mm.; length of head, 20 mm.

A single specimen from the Jacuhy. Besides the generic characters, the scales are larger than in the known species of Anacyrtus.

CHORIMYCTERUS TENUIS Cope, *Amer. Naturalist*, 1894, p. 67.

Char. gen.—Denticulate teeth on intermaxillary and dentary bones, and in a single row on the former. On the dentary bone a second interior series of simple teeth. Dorsal and anal fins short; the former commencing in front of the base of the latter. Nares separated by a wide space. Lateral line complete.

This genus is near to Characidium, but differs in having two series of mandibular teeth. From Piabucina it differs in the separated nostrils and the presence of a lateral line.

Char. specif.—Form slender; the depth contained seven times in the length less the caudal fin. Profile of muzzle decurved; mouth small, the end of the maxillary nearly reaching the anterior margin of the orbit. Eye large, oval, contained in the length of the head three times, and as wide as the interorbital space opposite its posterior border. Teeth of both jaws rather elongate, with a single lateral denticle on each side of and near the acute apex. Length of head five times in total length without caudal fin. Scale $\frac{3}{39}$. Fin radii, D. 11; A. 9; V. 9; P. 12. Pectorals elongate, not reaching ventrals; ventrals reaching about half-way to anal. Caudal fin deeply emarginate. Color silvery, most brightly on the suborbital and opercular regions. Scales with slightly shaded borders.

Total length, 66 mm.; length to base of caudal fin, 55 mm.; length to base of anal, 41 mm.; length to base of ventral, 27 mm.; length to base of dorsal, 22 mm.; length of head, 11 mm.

This fish is more slender than the *Characidium fasciatum* of Reinhardt, and has a different scale formula and coloration. It is still more slender than the *C. etheostoma* Cope, and *C. steindachnerii* Cope.

PSEUDOCORYNOPOMA DORIÆ. Perugia, *Ann. Mus. Genoa*, x, 1891, 646. *Bergia altipinnis* Steind., *Stzber. K. Akad. Wien*, 1891, 336.

Char. gen.—Dorsal fin originating above the anterior part of the elongate anal fin. Denticulate teeth on the premaxillary and dentary bones,

in two series on the former and one series on the latter; no canines. Nares close together. Pectoral and ventral regions compressed acute. Lateral line straight, continuous. Ventral fins small. Gill rakers lanceolate.

This genus is allied to Gasteropelecus, but the lateral line is of the normal type, that is, straight and continuous. From Piabucina, it differs in having two series of premaxillary teeth, and from Chalcinus in the absence of conical teeth between the dentary series. It is an interesting form connecting Gasteropelecus with Chalcinus.

Char. specif.—General form rhombic, the profile straight from the base of the dorsal fin to the extremity of the muzzle. Mouth opening obliquely upwards. Pectoroventral outline moderately and not extremely convex. Pectoral fin elongate, falcate, reaching anal; ventral not reaching anal. Scales $\frac{7}{40}$ Fin radii, D. 1.10; A. 37; V. 7; P. 13. Anterior rays of dorsal and anal fins in probably male individuals, produced, the former reaching the base of the caudal. The caudal deeply emarginate. Depth entering length 2.6 times; length of head entering same four times. Diameter of eye entering length of head (without chin) three times; and entering the interorbital width 1.25 times. General color silvery; a whiter silver band extending from near the epiclavicular region to the base of the caudal fin above the lateral line. No dark markings.

Total length, 67 mm.; length to base of caudal fin, 52 mm; length to base of anal (oblique), 36 mm.; length to base of dorsal (oblique), 32 mm.; length to base of ventral, 25 mm.; length to base of pectoral, 15 mm.; length of head, 13.5 mm.

This is apparently an abundant species in the Jacuhy. My specimens agree with those described by Steindachner from Montevideo, except that in the latter the eye is a little smaller, entering the length of the ead 3½ times, and there are 40–1 anal rays. The *P. argentinum* Holmb. from the Plata (*Revista Argentina*, 1891, p. 190) is, to judge from the description, a more slender fish, with the lateral line nearer the dorsal border.

TETRAGONOPTERUS RUTILUS Jenyns; Steindachner, *Sitzungsber. Wien Akad. Wiss.*, November, 1876, p. 17.

The five species of Tetragonopterus represented in the collection may be distinguished synoptically as follows:

a. No teeth on the maxillary bone.

Scales of lateral line, 40; anal rays, 28; eyes, ⅓ head, equal interorbital space; elongate ..... *T. rutilus.*

Scales of l.l., 36; anal rays, 28; eye, ¼ head, 1½ interorbital space; orbicular ..... *T. jacuhiensis.*

Lateral line, 32-3; anal rays, 23; eye, 2.5, equal interorbital space; rhombic ..... *T. eigenmanniorum.*

Lateral line, 37; anal rays, 20; head thick; eye, 3½, 1½ in interorbital; elongate ..... *T. laticeps.*

aa. Teeth on the base of the maxillary bone.

Lateral line, 35; anal rays, 19; eye large. 2½ in head, equal interorbital; elongate; no spots ..... *T. pliodus.*

In the *T. rutilus* the form is rather elongate, the depth entering the length (minus caudal fin), 2.66 times, while the head is short, entering the length 4.5 times. The eye is large, entering the length of the head three times, and equaling the width of the convex interorbital space. The maxillary is toothless and reaches the vertical line of the anterior border of the orbit. The muzzle is as long as three-quarters the diameter of the eye. Scale formula, $\frac{7}{40}$. Radii, D. 11; A. 28; V. 7, with a lanceolate scale at axilla. The pectoral reaches the base of the ventral, but the ventral does not reach the anal. Origin of dorsal a little posterior to that of ventral. The color is yellow silvery, whiter on the middle of the sides. Humeral and caudal spots obscure, the former not visible in some specimens; apparently vertical where obscurely visible. Median caudal rays black.

Total length, 135 mm.; length to base of caudal, 110 mm.; length to base of anal, 70 mm.; length to base of ventral (oblique), 50 mm.; length of head, 24 mm.

The specimens agree in the main with Steindachner's description,* although the number of scales of the lateral line is a little greater than is given by him. In outline of body our specimens are most like his elongated variety (Pl. ii, Fig. 3); but the head is shorter, since in the variety the head enters the length four times instead of 4.5 times.

A few specimens.

TETRAGONOPTERUS JACUHIENSIS sp. nov.

The deepest bodied species of the Jacuhy, rather deeper than the *T. maculatus* of Cuvier. The depth enters the length less the caudal fin 2.25 times, and the length of the head enters the same four times. The eye is rather small, entering the length of the head four times, while the interorbital space is 1.5 times its diameter. The profile of the head is slightly concave; and those of the back and belly are about equally convex. Scales $\frac{6-8}{36}$. Radii, D. 11; A. 27-8; V. 8, with axillary scale. First dorsal ray a little posterior to first ventral ray. Color silvery with steel-blue reflections. Humeral and basal caudal spots conspicuous, the former subround and situated in the centre of a pale area, which is bounded posteriorly by a vertical curved black border, sometimes indistinct. Caudal spot continued on middle caudal rays.

Total length, 114 mm.; length to base of caudal fin, 95 mm.; length

* *Sitzungsber. K. Wien Akad.*, November, 1876, p. 17.

to base of anal, 63 mm. ; length to base of ventral (oblique), on 45 mm. ; length of head. 23 mm.

This species is allied to the *T. maculatus* Linn., but that species has a larger eye (one-third head) and a longer anal fin (32–3 rays). *

The number of rays is so constant in numerous specimens, that, if Steindachner's figures are correct, which there is no reason to doubt, this form must be distinct. The *T. maculatus* is ascribed by both Boulenger and Von Jhring to Rio Grande do Sul.

The proximal part of the maxillary bone is minutely serrate, but not dentate.

Fifteen specimens.

TETRAGONOPTERUS EIGENMANNIORUM sp. nov.

A species of rhombic form, differing from those above described in the smaller number of anal radii, and fewer scales of the lateral line. Depth entering length without caudal fin two and a half times ; length of head in the same 3.4 times. Eye large, longer than muzzle, entering head three times, and equal interorbital width. Scales $\frac{7}{32}$. Radii, D. 11 ; A. 23. Ventral commencing a little anterior to first dorsal ray, not reaching anal. Pectoral reaching ventral. Profile of head very slightly concave. Dorsal and ventral profiles subsequently arched. Color silvery, with a whiter silvery lateral band. No humeral nor distinct caudal spot. Middle caudal rays dusky.

Total length, 67 mm. ; length to base of caudal fin, 53 mm. ; length to base of anal, 35 mm. ; length to base of ventral (oblique), 26 mm. ; length of head, 15 mm.

But one specimen presents exactly the typical characters of this species, but five others probably belong to it. They have a few more scales of the lateral line, as 33–4, and one has 36. They have a basal caudal spot, and four of them show traces of the humeral spot, and have a steel-blue reflection, as in the *T. jacuhiensis*. The small number of the anal rays, 23–4, distinguishes it from the latter, where there are always 27–8 ; and the form is more elongate.

This species is dedicated to Prof. and Mrs. C. H. Eigenmann of the University of Indiana, whose work on the fishes of South America has so elucidated the subject.

TETRAGONOPTERUS LATICEPS sp. nov.

Form, elongate oval ; depth entering length (without caudal fin) 2.6 times ; length of head into same, 3.75–4 times. Profile of back descending regularly from dorsal fin ; of front, straight or slightly concave. Diameter of eye greater than length of muzzle, entering 3 to 3.3 times in length of head. Front slightly convex transversely, wider than diame-

* Teste Steindachner, *l. c.*, p. 10.

ter of eye, and entering length of head 2.33 to 2.5 times. Scales, $\frac{6}{37}$; Radii, D. 11; A. 20. Pectoral fin reaching base of ventral; ventral not reaching anal. No denticulations on maxillary bone. Color, silvery; a silver lateral stripe, with humeral and caudal spots. The humeral spot is subround and the caudal extends to the end of the median caudal rays.

Total length, 74 mm.; length to base of caudal fin, 60 mm.; length to first anal ray, 40 mm.; length to base of ventral (oblique), 28 mm.; length of head, 16 mm.

Eighteen specimens of this species are before me. It is allied to the *T. fasciatus* Cuv., *T. brevimanus* Gunther, and *T. jenynsii* Steindachner. The body is deeper than in the first named, and the frontal region is wider; the muzzle is shorter and the maxillary bone is not denticulate. From *T. brevimanus* it differs in the deeper body, larger eye, and longer pectoral fin. The *T. jenynsii* has a narrower front, only 33 scales of the lateral line, and the humeral spot a vertical bar. According to Steindachner's figure, the dorsal outline descends towards the dorsal fin; in *T. laticeps* it rises to that fin I would have suspected that this species might be the *T. ihringii* of Boulenger, but one of the principal characters of that species, as well as of the *T. alburnus* of Hensel, is that it has but 10 dorsal radii. The *T. obscurus* Hens. has the interorbital diameter equal the eye, and a vertical humeral spot.

TETRAGONOPTERUS PLIODUS sp. nov.

Form rather elongate, depth entering length (less caudal fin) three times; length of head entering the same four times. Maxillary bone extending beyond anterior border of orbit, supporting several tridenticulate teeth on its proximal portion. Eye large, much exceeding muzzle, entering length of head 2.25 times, and a little exceeding the interorbital width. Scales, $\frac{4}{\frac{35}{4}}$. Radii, D. 10; A. 19; V. 9. Pectorals not reaching ventrals, nor ventrals the anal fin. Dorsal originating a little posterior to line of origin of ventrals. Silvery, with a broad, distinct, silver lateral band. No spots of any kind.

Total length, 70 mm.; length to base of caudal fin, 57 mm.; length to base of anal, 38 mm.; length to base of ventral (oblique), 26 mm.; length of head, 13 mm.

This is apparently a rare species, only two individuals being contained in the collection. It has many peculiarities, one of which is the possession of only ten rays in the dorsal fin. It shares this character with the *T. alburnus* of Hensel from the same region, but this species has 27 rays in the anal fin and the body is more elongate. It has some points in common with the *T. ihringii* (Boulenger, *Amer. Magaz. Nat. Hist.*, 1891, p. 172). Boulenger does not mention the maxillary teeth, which he could scarcely have overlooked. It has also one or two additional rows

of scales above the lateral line, and has the humeral and caudal spots, which are wanting in the *T. pliodus*.

HEMIGRAMMUS LUETKENII Boul. *Tetragonopterus luetkenii* Boulenger, *Ann. Mag. Nat. Hist.*, 1891, p. 173. *Chirodon luetkenii* von Ihring, *Süsswass. Fische v. Rio Grande do Sul*, 1893, p. 22.

Form deep ovate, outlines of body equally convex. Profile of front straight, a slight concavity above line of preopercle. Depth of body into length (less caudal fin), two and a half times; length of head into the same, four times. Eye large, its diameter greater than length of muzzle, a little less than interorbital width, and entering length of head 2.8 times. Scales, $\frac{5\text{–}5\frac{1}{2}}{\frac{32}{4\frac{1}{2}}}$. Radii, D. 11; A. 23. Pectorals not reaching ventrals, and ventrals not reaching anal. No teeth on the maxillary bone. Tubes of lateral line on eight to twelve scales. Dorsal fin originating a little behind vertical line of origin of ventrals. Color, silvery; a silver band on side. Humeral spot large, distinct, subround; caudal spot distinct, extending to extremities of median caudal radii.

Total length, 76 mm.; length, without caudal fin, 60 mm.; length to origin of anal, 40 mm.; length to origin of ventral (oblique), 29 mm.; length of head, 10 mm.

This species differs from the *H. robustulus* Cope in its more compressed head and in the absence of teeth on the maxillary bone. An abundant species in the Jacuhy.

CHIRODON MONODON sp. nov.

A single crenate tooth on the proximal extremity of the maxillary bone. General form rhombic oval. Depth in length, less caudal fin, 2.6 times; length of head in the same, 3.6 times. Eye large, its diameter exceeding length of muzzle, equaling interorbital width, and entering length of head 3 times. Scales, $\frac{5}{\frac{32}{4\frac{1}{2}}}$. Radii, D. 10; A. 19–22. Pectoral reaching ventral, and ventral nearly reaching anal. Origin of dorsal a little posterior to that of ventral. Lateral line extending on 9–10 scales. Silvery; an indistinct, narrow, dusky line visible on the middle of the side from the caudal fin to below the dorsal.

Total length, 46 mm.; length to base of caudal fin, 35 mm.; length to base of anal, 23 mm.; length to base of ventral, 15 mm.; length of head, 9 mm.

This small species has a scale formula about as in the *Hemigrammus ihringii*, but there is but one series of premaxillary teeth; there is a tooth on the base of the maxillary bone, and there are only ten dorsal rays. The number of anal rays is somewhat variable. Of the three specimens, one has 19 rays, the second 20, and the third 22. This is a deeper bodied form than the *C. pisciculus* Gird., and the only other spe-

cies, *C. interruptus* Jen., is said to have 11 dorsal rays and no maxillary teeth.

DIAPOMA SPECULIFERUM, *Amer. Naturalist*, 1894, p. 67.

Char. gen.—Adipose fin present. Dentition as in Tetragonopterus, *i. e.*, with two rows of denticulate teeth on the premaxillary bone and one row on the dentaries. Origin of the short dorsal fin entirely posterior to that of the ventrals. Anal fin elongate. Belly not keeled. The operculum produced posteriorly below the lateral line to an apex. Lateral line not complete. Nares close together. Inferior limb of external branchial arch without rakers.

This genus is allied to Hemigrammus, but has a peculiarly formed operculum, which displays a tendency towards the character which is so much developed in Corynopoma Gill.*

Char specif.—Form rather elongate, the depth entering the length 3.25 times (less caudal fin). Length of head entering the same 3.6 times. Maxillary bone elongate, reaching the line of the anterior border of the pupil, supporting 4–5 teeth at its proximal end. Eye large, its diameter exceeding the length of the muzzle, equaling interorbital width, and entering length of head three times, one diameter equaling the long horizontal diameter of the operculum and suboperculum. The latter two elements form a subtriangular plate, of which the long diameter is horizontal, and of which the base is continued as a process along the posterior border of the preoperculum. The apex of the triangle is formed by the extremity of the suboperculum, and is obtuse. Scales, $\frac{4}{37}{}^{-}_{5}$; lateral line pores and tubes present on ten scales behind the epiclavicle, and on eight scales anterior to the caudal fin. Radii, D. 1.9; A. 2.29; V. 7; P. 11. Pectorals just reaching ventrals, and ventrals not reaching anal. Caudal deeply emarginate, a curved patch of scales extending on the inferior lobe from the base. Anal fin with its free border concave, the anterior rays longer than the posterior, and the posterior longer than the middle rays.

Sides, excepting the dorsal portion and that part adjacent to the anal fin, with a mercury-like metallic surface; the operculum most brilliantly refulgent, the cheeks little less so. A straight leaden line from the head to the base of the caudal fin. No spots.

Total length, 45 mm.; length to base of caudal fin, 36 mm.; length to base of anal, 22 mm.; length to base of ventrals, 17 mm.; length of head, 10 mm.; length of head to preoperculum, 6 mm.

But one specimen of this curious little fish was sent by Mr. Smith. It is the most brilliant of the Characinidæ known to me.

*This genus received several names from Prof. Gill at the same time. Of these, Dr. Günther selected Corynopoma, as he had a right to do, and he has been followed in this by most other ichthyologists. One of the other names cannot therefore be now selected for this genus because it was printed on a previous page, as has been recently proposed.

CURIMATUS GILBERTII Q. and G.

Numerous specimens.

STERNOPYGIDÆ.

CARAPUS FASCIATUS Pallas.

STERNOPYGUS VIRESCENS Val.

Apparently abundant.

NEMATOGNATHI.

SILURIDÆ.

RHAMDIA SAPO Val.

Five specimens which agree with the description given by the Eigenmanns, except in the possession of narrower bands of premaxillary and dentary teeth. The premaxillary patch is five times as long as wide.

RHAMDELLA STRAMINEA sp. nov.

Surface of posterior cranial bones fossate, but covered with a thin skin. Fontanel reaching base of supraoccipital process, with a narrow bridge opposite the posterior border of the orbit. Adipose fin entering the length (to base of caudal) five times, and equal to depth of body; length of head entering total, four times. Upper lip projecting a little beyond lower; tooth band in both jaws wide; teeth well developed. Eye 4 times in length of head to angle of operculum; one and a third times in interorbital width, and one and a half times in length of muzzle. Centre of pupil nearer end of muzzle than opercular angle. Maxillary barbels reaching middle of ventral fins; external mentals reaching base of pectoral fins; middle mentals half as long as externals. Dorsal spine rather slender, elongate, toothless; pectoral spine more robust, longer than soft rays, with eight robust spines on its internal border, and more numerous smaller dentations on the anterior border, which are not recurved. Radii, D. I 6; A. 13; P I. 8. Caudal fin deeply emarginate, the superior lobe a little longer than the inferior.

Total length, 85 mm.; length to base of caudal fin, 68 mm.; length to base of anal, 50 mm.; length to base of ventral, 33 mm.; length to base of pectoral, 19 mm. Length of head to apex of supraoccipital process, 21 mm.

Color in spirits, brownish straw-color, with silvery opercle, rather sparsely dusted with black specks. Adipose fin dusky bordered.

Five specimens of this species, which approaches the *R. jenynsii* Gthr., according to the detailed description given by the Eigenmanns. That species is said to have the eye only one-fifth the length of the head, and the adipose fin is one-fourth the total length. The occipital process is said to be covered with a thick skin. In the *R. straminea* this process is rugose and is covered by a very thin skin, and approaches quite near to the dorsal plate. From the *R. eriarcha* E. and E., from the Uraguay

river, this species differs in the proportions of the eye and head, the much longer barbels, much shorter adipose fin, etc.

PIMELODUS NIGRIBARBIS Blgr., *Proceeds. Zoöl. Soc.*, London, 1891, p. 232, Pl. XXV, Fig. 1.

Several specimens.

LORICARIA CADEÆ Hensel, *Archiv. f. Naturgesch*, 1868, p. 369.

Represented by four specimens of rather small size. The muzzle is depressed and is acuminate when viewed from above, and its length from the orbit enters the length of the head to the posterior extremity of the occipital plate two and a half times. The edges of the muzzle are hispid but not bristly. The abdomen is covered with a continuous series of scales, of which the lateral are elongate and directed forward, and the median smaller and in two rows. Those between the ventrals are distinct but solidly united, and there is a single anal which is notched in front for the anus. The scuta of the nape are furnished with obtuse keels, one on each side, which form a pair of ridges which converge forwards and are continued on the occipital plate until they approach quite closely. They then diverge and terminate above the postorbital plate. The third median nuchal plate is not ridged, but a lateral plate which joins it and the second nuchal on each side has a keel. There is no keel posterior to this, nor any between it and the superior keel of the lateral line. The space between the nostrils forms a median narrow ridge which bifurcates posteriorly, each half disappearing above the middle of the supraorbital border, from which it is separated by a groove, which is a posterior continuation from the nareal fossa. The central premaxillary ridge is divided by a narrow median groove, and a shallow groove bounds the lateral plates on each side, terminating in a preorbital fossa. Scales of lateral line, 28–29; the lateral keels uniting on the eighteenth scale. Diameter of eye, without the shallow notch, entering length of head 5.5 times and interorbital width 1.25 times.

The length of the head to the end of the occipital plate enters the length (less the caudal fin), 5.25 times; and the width of the head enters its length 1.4 times; the depth of the head enters the length of the same twice. Premaxillary jaws not separated by an emargination, but firmly united. Teeth, $\frac{4}{4}$. Lips coarsely and shortly fringed all round, the posterior coarsely tubercular and not notched posteriorly. Beard shorter than diameter of eye. The dorsal spine enters the total length (less caudal fin) 4.25 times, and the anal spine enters the same 5.6 times. Radii, D. I. 7; P. I. 6; V. I. 5; A. I. 5. The pectoral fins just reach the ventrals, and the ventrals the anal. The marginal rays of the caudal are not stronger than those of the other fins. Its border is concave, and the superior apex is a little longer than the inferior, and it is without filamentous prolongation.

Color light brown above, yellowish below. Five brown cross-bands on

the dorsal region and one on the nape. Five obscure dusky spots on the lateral border of the head to the opercular fissure. Dorsal fin with a dark spot near the extremity. Caudal with a dark spot at each apex and two at the base. Anal, ventrals and pectorals dusky at the extremity.

Total length, 78 mm.; length to base of caudal fin, 66 mm.; length to base of anal fin, 31 mm.; length to base of ventral, 21 mm.; length to base of pectoral, 11 mm.; length to end of occipital plate, 15 mm.

The only species which it is necessary to compare with this one is the *Loricaria konopickyi* of Steindachner.* According to this author this species resembles the *L. cadeæ* in most essential respects. It has, however, two lines of keels between the dorsal spine and the lateral ridge, where none exist in the *L. cadeæ*, and the middle rows of abdominal scales are in five rows instead of three. The teeth are nine or ten instead of six or seven, and the keels of the lateral scales come together on the fifteenth instead of the eighteenth row. The muzzle enters the head length 2.5 times instead of twice. The *L. konopickyi* is from the Amazon basin.

Loricaria lima Kner, to which this species is referred as identical by Von Jhring, differs as follows: The head enters the length 4.66 times; the superior ray of the caudal fin is produced; the eye enters the head 7.5 times; the fins are spotted.

LORICARIA SPIXII Steindachner, *Denkschr. Wien Akad. Wiss.*, 1881, 18; Pl. ii. Several specimens.

HISONOTUS LÆVIOR sp. nov.

Form rather slender, the depth at the base of the first dorsal ray entering the length to base of tail, six times; and equaling the length of the muzzle anterior to the orbit. Eye small, entering length of head five times, and three and a half times in the nearly flat interorbital space. Venter not entirely covered with scales, there being a series on each side, and a row of smaller ones in the middle, separated from them by a naked space. Median series expanding into a shield just posterior to bases of ventral fins. Dorsal and ventral aspects of caudal region rounded. Scales posteriorly moderately hispid, smoother anteriorly; on the top of the head the prickles very small. Lower lip convex, with narrow margin, and coarsely tubercular surface.

Origin of dorsal fin a little posterior to line of origin of ventrals. Caudal fin with the inferior angle produced a little farther than the superior. Spines of fins only moderately hispid, except towards the extremities of the pectorals, where the prickles are coarser. Radii, D. I. 7; P. I. 7; V. I. 5; A. I. 5. Scales of lateral line, twenty-eight. The pectoral fins reach the middle of the length of the ventrals, but the latter do not reach the anal.

* *Denkschriften math. Wiss. Klass. Kais. Akademie d. Wissensch.*, 1879, p. 45, Pl. vi, Fig. 3, and Pl. vii, Fig. 1.

Color, light brown. The dorsal fin is sparsely and the caudal fin is closely spotted with blackish, and the spinous rays of both are light colored with dusky spots.

Total length, 52 mm. ; length to basis of caudal fin, 41 mm. ; length to base of anal, 25 mm. ; length to base of ventrals, 16 mm. ; length to line connecting bases of pectorals, 10 mm.

A single specimen from the Rio Jacuhy, Rio Grande do Sul.

This is the third species of the genus now known, the one first described being the *H. notatus* of Eigenmann.* This species is said to be characterized by the presence of a triangular posterior process of the occipital element, and by the compressed and elevated form of the head ; characters not seen in the present species. The orbit is smaller, but the interorbital space is only as wide as three of its diameters. It has only twenty-five plates of the lateral line. The *Hisonotus nigricauda*† of Boulenger differs in the twenty-five plates of the lateral line, the I. 5 pectoral rays, the more numerous rows of ventral plates and the larger eye.

HISONOTUS LEPTOCHILUS sp. nov.

Form rather slender; head rather depressed. Depth at first dorsal ray entering length to base of caudal fin, 5.5 times. Eye small, entering length of head 5.5 times, and three times on the rather flat interorbital space. Venter covered with from ten to twelve rows of scuta, a single row on each side anteriorly, larger than the others. Caudal region rounded above and below. Hispid everywhere, especially on the supertemporal region. Three transverse and a median rhombic scuta between the occipal scute and the base of the dorsal spine. Lower lip thin, with thin transverse posterior margin and inconspicuous tubercles.

Dorsal fin originating a little posterior to ventrals. Pectorals reaching middle of ventrals ; ventrals barely reaching anal. Inferior angle of caudal fin a little longer than the superior. Radii, D. I. 7 ; P. I. 6 ; V. I. 5 ; A. I. 5. Scales of lateral line, 28.

General color dusky, with numerous small pale spots everywhere, most conspicuous when the fish is immersed in fluid. Fins lighter, conspicuously spotted with dusky.

Total length, 54 mm. ; length to base of caudal fin, 44 mm. ; length to base of anal, 35.5 mm. ; length to base of ventrals, 17.5 mm. ; length to base of pectorals, 10 mm. ; interorbital width, 6 mm.

The important characters which distinguish this species from the *H. lævior*, are the thin and truncate lower lip with feeble tuberculation ; the numerous ventral plates ; the narrower interorbital space, and the greater hispidity, especially of the head. It differs from the *H. notatus* in much the same way as the *H. lævior*.

* "Revision of South American Nematognathi," *California Acad. Sciences*, 1890, p. 391.

† *Proceeds. Zoöl. Soc.*, London, 1891, p. 234.

HISONOTUS NIGRICAUDA Boulenger. *Otocinclus nigricauda*, Boul., *Proceeds. Zoöl. Soc.*, London, 1801, p. 234; Pl. xxv, Fig. 3.

One specimen. This species differs from those described above, in the presence of only two nuchal scuta between the occipital bone and the base of the first dorsal ray, as represented in Boulenger's figure. In this point it agrees with the two species of Otocinclus to be described below. In the two species of Hisonotus referred to, there are four nuchal plates crossing the same space.

The specimen of *H. nigricauda* measures, only 30 mm. The sides and posterior two-thirds of the middle line of the belly are squamous, the remainder smooth.

OTOCINCLUS FLEXILIS sp. nov.

Head large, muzzle rather short, width posteriorly equal depth of body at first dorsal spine, and entering the length less the caudal fin four and a quarter times. Eye entering length of head four times, and interorbital width three times. Body compressed; superior and inferior aspects of caudal peduncle flattened, and separated from sides by an angular keel. Surfaces everywhere hispid. Perforations of supratemporal plate numerous. Lower lip very thin, and entirely smooth. Plates of belly in two lateral rows which are directed forwards, and are separated by a single row on the middle line, which is sometimes more or less incomplete, thus permitting those of the lateral series to come in contact. Occipital plate angulate posteriorly, and separated from dorsal spine by two transerse plates and a small median posteriorly.

The pectoral spines reach the base of the ventral fins, and the ventrals fall considerably short of the anal. Caudal lobes acute, subequal. Radii, D. I. 7; P. I. 6; V. I. 5; A. I. 5. The spines are all strongly hispid, and those of the pectoral fin are more robust than that of the dorsal. Plates of lateral line, 25.

Light yellowish brown, with a row of about six oblong dusky spots along the lateral line, which become obscure anteriorly. A series of corresponding spots along the dorsal region. Dorsal and caudal fins light colored with numerous dusky spots. A black spot at the base of the caudal fin in some specimens.

Total length, 56 mm.; length to base of caudal fin, 43 mm.; length to base of anal, 27 mm.; length to base of ventral, 19 mm.; length to base of pectoral, 10 mm.; length of head, 10 mm.; interorbital width, 7.5 mm.

This species need only be compared with the *O. affinis* of Steindachner, which is found near to Rio de Janeiro. That species has a posterior tuberosity of the occipital plate which is wanting in this species, and Steindachner represents only one entire plate between the occipital and the base of the dorsal spine. This region is more depressed in the *O. flexilis*, and the body is considerably more compressed, from the dorsal to

the caudal fins. The eye is also smaller than in the *O. affinis*. The lip is even weaker than in the *Hisonotus leptochilus*.

Rio Jacuhy, Rio Grande do Sul; numerous specimens.

OTOCINCLUS FIMBRIATUS sp. nov.

Form moderately stout; depth at base of D. I. entering length without caudal fin, four times. Head rather depressed with the muzzle rounded, entering the length (measured to opercular border) three and a half times. Eye entering length of head 4.25 times, and the flat interorbital space 2.75 times. Posterior lip well developed, coarsely tubercuiar, its border, together with the border of the anterior lip and the inner edge of the beard, fringed with obtuse processes. Occipital plate with acute apex, separated from base of dorsal spine by two transverse plates and a small median posterior one. Venter with three series of scuta; a lateral series of long ones directed forwards on each side, and a row of median scuta in contact with them. Scales everywhere hispid. Supratemporal perforations small, numerous, but concealed by the integument. Inferior and superior aspects of caudal region flattened, and separated by an angular keel from the sides.

Origin of dorsal fin immediately above that of the ventral. Caudal lobes acute, equal. Radii, D. I. 7; P. I. 6; V. I. 5; A. I. 5. Pectorals reaching a little beyond base of ventrals; latter barely reaching base of anal. Twenty-five rows of scuta in lateral line.

Color, light reddish yellow. There are four large dusky spots along the lateral line, the anterior enlarged and obscure. A series of corresponding dorsal spots. Caudal fin with three vertical dusky bars, which are sometimes broken into spots. Other fins with a dusky spot at base; the anal and dorsal with the spinous ray entirely dusky. Below, straw color.

Total length, 38.5 mm.; length to base of caudal fin, 28 mm.; length to base of anal, 18.5 mm.; length to base of ventral, 13 mm.; length to base of pectoral, 7.5 mm; interorbital width, 5.5 mm.

This is the smallest of the Siluridæ here described, and is to be compared with the *Otocinclus affinis* already mentioned. The angulation and elevation of the nuchal region described by Steindachner as characteristic of that species are here wanting, and the fringe of the lips is not figured nor described by him. The eye is considerably smaller, entering the length of the head to the apex of the occipital shield 5.5 times instead of four times. In the *O. affinis* there is a longitudinal lateral band instead of spots, and the fins are not represented as spotted, as is the case with the *O. fimbriatus*. As compared with the *O. flexilis*, the *O. fimbriatus* differ greatly in the tubercular and fringed lip, relating to it in this respect much as the *Hisonotus lævior* does to the *H. leptochilus*. It is a smaller species than the *O. flexilis*, and is more brightly colored and with less numerous lateral spots. The ventral fins are relatively longer, and the

dorsal fin originates above their base, and not behind it, as is the case in *O. flexilis*.

Rio Jacuhy, Rio Grande do Sul ; numerous specimens.

In the many specimens of this species and the *O. flexilis* in the collection, the adipose fin spine is constantly wanting.

PLECOSTOMUS COMMERSONII Val.

One adult specimen. A young individual, which I suppose to belong to this species, exhibits the following characters :

Scuta not connected with each other anterior to the posterior border of the dorsal fin, and consisting of a median ossification only, each scute supporting a median comb of bristle-like teeth, which is longitudinal on most of them and is directed obliquely upwards posteriorly on the superolateral series. Besides the central comb, each scute has a shorter one near its superior and inferior extremities. Inferior surface, as far as the vent, without granules or scales. Scuta of lateral line, 28. Traces of a longitudinal angle on the posterior part of the supratemporal plate, and of two near together on the posterior part of the occipital. Head marked with coarse granular ridges, which are little marked on the suborbital and interorbital regions, and are replaced by fine lines on the anterior part of the occipital plate. Muzzle acuminate oval, viewed from above ; tip naked ; sides without bristles. Occipital bounded posteriorly by a single nuchal plate, which is separated from the basal dorsal fin plate by a second nuchal. Lip large, entire, coarsely tubercular. Teeth about $\frac{4-5}{1-5}$ on each side. The humeral angle extends on two plates only.

Fin radii, D. I. 7; P. I. 6 ; V. I. 5 ; A. 5. The eye enters the length of the head to the apex of the occipital plate six times, three times in the muzzle, and 2.25 times in the interorbital space, which is plane. The base of the dorsal fin is as long as the space from its posterior ray to half way between the adipose fin and the base of the caudal. The pectoral extends a little beyond the base of the ventral, and the ventral to a short distance beyond the posterior ray of the anal fin. The inferior apex of the caudal fin is considerably longer than the superior.

Total length, 47 mm.; length to base of caudal fin, 34 mm.; length to base of anal fin, 23 mm.; length to ventral, 17 mm.; length to base of pectoral, 9 mm., length of head to apex of occipital plate, 13 mm. Color in alcohol, reddish brown, an obscure dark shade about the base of the dorsal fin. A single row of dusky spots in each membranous space of the dorsal fin. Caudal fin with about three oblique vertical cross-rows of rufous spots.

The single specimen on which this description is founded is probably young, yet various indications point to its being of small size at maturity. The well-developed lip and tubercles are those of a mature fish, and the relatively small size of the eye indicate that little change is to be looked for in the proportions of the head. It is probable that the deficient ossification of the anterior body plates is a character of immaturity.

PLECOSTOMUS ASPILOGASTER sp. nov.

Head with three obtuse angles; the lateral extending posterior to the orbits; the median obscure between the orbits, but distinct on the occipital plate. Belly covered with granular scales which are collected into indistinct scuta posterior to the lip. Posthumeral ridge short, covering only four or five scuta. Besides this, the scuta are not keeled, but are distinctly angular on the dorsolateral and ventrolateral rows, and traces of keels exist on the anterior scuta of the two median lateral rows. Occipital plate bounded posteriorly by two scuta which are obtusely angulated, and these are separated from the base of the dorsal spine by three transverse nuchal plates, each of which has an obtuse lateral angle of the surface. There is a naked patch on the end of the muzzle, which does not reach the superior surface. Eye small, entering length of head eight times, muzzle five times, and interorbital space 3.75 times. Lateral line of scuta, 30. All the scuta are rough with longitudinal ridges, but they are not very spinous. Inferior and superior surfaces of caudal peduncle flattened. Length of head entering total (without caudal fin), three and one-third times.

Base of dorsal fin equal space between its posterior ray and a point half way between adipose and caudal fins. First dorsal ray equal length of head; shortest caudal rays equal from end of muzzle to posterior border of orbit. Radii, D. I. 8 in three specimens, I. 9 in one; P. I. 6; V. I. 5; A. 5. Pectoral extending to basal third of ventral; ventral to posterior border of anal. Teeth $\frac{4}{4}\frac{9}{9}$ on each side the terminal portion elongate, amber-colored. Length of median caudal rays .66 of length of head.

Total length, 250 mm.; length to base of caudal fin, 198 mm.; to base of anal, 122 mm.; to base of ventral, 82 mm.; to base of pectoral, 41 mm. Length of head to posterior border of occipital plate, 54 mm.; width of head at opercular fissure of lateral angle, 49 mm. Length of specimen with dorsal radii I. 9, 275 mm.

Color above, dark brown, spotted anteriorly with dusky; below unspotted light brown. There are two or three dusky spots on each scuta, but these are not visible posterior to the dorsal fin. The head is closely spotted with very small dusky spots, which are large and more distinct on the supratemporal region, where they have a diameter of about a millimeter and are separated by spaces of about the same diameters. The dorsal fin is coarsely spotted with dusky, there being one or two rows on each interspinous membrane. The pectorals, ventrals and anal are similarly spotted, with a single row between the spines, and the caudal fin is unspotted.

In general proportions, and in the fin and scale formula, this species resembles the *P. commersonii*, but in various other respects it apparently resembles the *P. carinatus* of Steindachner. It differs from this species in the very obscure or absent carination, in the much smaller eye, and in the shorter base of the dorsal fin, according to its describer. It is from

the Jutahy in Western Amazonia. The four specimens of the *P. aspilogaster* before me are from the Jacuhy, Rio Grande do Sul. This species also approximates the *P. limosus* Eigenm. (*Proceeds. Calif. Acad. Sci.*, 1888, pp. 167–8), from the Uraguay R. According to the description this species has the occipital plate bordered by a single nuchal instead of by three, and the middle rays of the caudal fin are nearly equal to the length of the head. The postdorsal region should be rounded above and below, whereas it is flattened, and the fins and belly are spotted. In the *P. aspilogaster* the caudal fin and belly are without markings.

The *Plecostomus virescens* Cope (*Proceeds. Academy, Philadelphia*, 1874, p. 137) was founded on young individuals from Eastern Peru. The Eigenmanns state their inability to locate it in their system of Nematognathi. In their table of the genus Plecostomus (*l. c.* p. 398) is a section which includes species with the ventral integument more or less scaleless, a character which Boulenger alleges to be more or less untrustworthy. In any case two specimens of the *P. virescens* of 60 mm. in length have the belly smooth. In one of 70 mm. a few granules appear on the median line of the belly. In one of 92 mm., a band of granules extends from the anus to the coracoid bridge on the middle line spreading and fading out laterally on the belly. Supposing the latter character to be retained to maturity (which is uncertain) the *P. virescens* differs from the species referred to the section with naked bellies by the Eigenmanns. Disregarding the squamation of the belly, the former enters the section which includes the *P. bicirrhosus*. The l.l. is 26–7. Superciliary borders a little raised. The triangular part of the occipital bone is bordered by two scuta on each side, and one scutum which touches the apex, and none of them are angulated. Body scales not keeled. The base of the dorsal equals its length from the adipose fin. A few small spines at the inferior opercular angle. Head and body unspotted. All the fins spotted. Apparently nearest the *P. villarsii* Luetken.

CALLICHTHYS TAMOATA Linn.

CORYDORAS PALEATUS Jenyns. *C. marmoratus* Steind., *Denkschr. K. Akad. Wien*, 1879 (see Pl. v, Fig. 1); good figure.

About sixty specimens, varying in length from 35 mm. to 70 mm. I have examined about fifty of these in order to ascertain whether there is any variation in the degree of extension of the coracoid bones over the pectoral region. There is no variation, that of each side remaining widely separated from the corresponding one of the other side in all the specimens. Not having met with any variation in any of the species in this respect, I distinguished the species where the pectoral region is enclosed below by the coracoids, as a distinct genus, retaining for it the name Corydoras, and naming the series with naked breast, Gastrodermus.* According to Eigenmann,† the type of Corydoras, *C. punctatus* L., possesses

* *Proceeds. Amer. Philos. Soc.*, 1878, p. 681.

† *Revision of S. Amer. Nematognathi*, 1890, p. 405.

the character which I have assigned to Gastrodermus, which is therefore the true Corydoras. It therefore becomes necessary to give the genus with armored thorax a new generic name. This I propose shall be Osteogaster. The type is the *Corydoras eques* of Steindachner, and the only other species which can be positively assigned to it is, according to Eigenmann, the *C. splendens* Castelnau.

ICHTHYOCEPHALI.

Prof. Gill has called my attention to an error which occurs in my paper on the classification of fishes published in 1871, in the exchanged places of the genera Monopterus and Symbranchus. The characters of the one are by an inadvertence ascribed to the other, by an accidental exchange of the names.

SYMBRANCHIDÆ.

SYMBRANCHUS MARMORATUS Bloch.

HAPLOMI.

CYPRINODONTIDÆ.

GIRARDINUS CAUDIMACULATUS Hensel., *Arch. f. Naturgesch.*, 1870, p. 362; Von Jhring, *Süsswasserf. v. Rio Grande do Sul*, 1893, p. 28.

Depth of body a little greater than length of head. Dorsal fin originating above middle of anal. Scales 28–8. Radii, D. I. 7; A. 10. Eye one-third head, exceeding length of muzzle, and 1.5 times in interorbital width. Scales between interorbital space and dorsal fin, 18. Yellowish with a black vertical spot on the thirteenth scale from the caudal fin.

PERCOMORPHI.

CICHLIDÆ.

CRENICICHLA LEPIDOTA Heckel; Steindachner, *Sitzber. K. Wien Akad. Wiss.*, 1874, p. 22.

Numerous specimens; evidently the common perch of the Jacuhy.

CRENICICHLA LACUSTRIS Cast.; Steindachner, *Sitzber. K. Wien Akad. Wiss.*, Dec., 1874, p. 18.

Form elongate, body compressed; profile gently decurved from the first dorsal ray to the upper lip, which is less produced than the prominent mandible. The length of the head is contained in the total 3.66 times, and into that of the head and body three times. Depth of body contained in total 5.5 times, and into that of head and body 4.5 times. Eye not large, entering length of head 6.5 times; twice in muzzle without chin, and 1.6 times in interorbital space, which is slightly convex transversely. Scales $\frac{7-9}{22}$; those of the lateral line fewer than those of the transverse rows, for the reason that on the anterior part of the body one lateral line scale is bounded by three scales of the transverse rows, and

on the posterior part of the body, one lateral line scale corresponds to two transverse rows. Thus the transverse rows number 72, while there are only 40 in the lateral line. Fin radii, D. XX. 12; A. III. 9; V. I. 5; P. 17. Color brownish above and yellowish below in alcohol. Sides of body and head with dorsal and anal fin rather sparsely spotted with small black spots. A much larger black spot at the base of the caudal fin, which is not light bordered. A black band from the eye, the opercular border, and another very distinct one from the eye downwards across the cheek. Paired fins uniformly yellowish.

Total length, 196 mm.; length to base of caudal fin, 168 mm.; length to base of anal, 115 mm.; length to base of ventral, 89 mm.; length to base of dorsal (axial), 53 mm.

The number of transverse rows of scales is intermediate in the genus, while the number of those traversed by the lateral line is smaller than is mentioned by authors as occurring in any known species. The prominence of the lower jaw approximates a character of the *C. lucius* Cope, of the upper Amazon, but in that species the top of the head is flat and horizontal and not convex and decurved. The scales are also larger.

But three specimens of this fish were taken by Mr. Smith. The smallest measures 137 mm. in total length and differs as a younger individual in the larger eye, which enters the head 4.75 times, and equals the interorbital width. Radii, D. XXII. 13; A. III. 9. Scales $\frac{9}{11}\frac{}{22}$, the transverse series twice as numerous as those of the lateral line posteriorly, and three times as numerous anteriorly. Besides the black specks there is a row of eight dusky spots on the side of the body.

GEOPHAGUS GYMNOGENYS Hense', *Arch. für Naturgesch.*, 1870, p. 61; Von Jhring, *Süsswasser Fische von Rio Grande do Sul*, 1893, p. 31.

I find four species of *Geophagus* in the Smith collection, which differ as follows:

a. Cheeks naked or nearly so.

Profile nearly straight; eye one-third head; caudal fin emarginate; anal soft rays, 8; body oval; smaller..... *G. gymnogenys.*

Profile of skull strongly convex at orbit; eye one-third head; outline of body contracting from first dorsal spine posteriorly; caudal fin truncate; anal soft rays, 8; smaller..... *G. camurus.*

aa. Cheeks scaly.

Profile straight, preorbital bone wider; caudal fin truncate; anal with eight soft rays; eye one-fourth head; l. l., 25; smaller.. *G. brachyurus.*

Profile straight; preorbital bone much wider; eye more than four times in head; body oval; l.l., 28; anal with nine soft rays; caudal fin rounded; larger..... *G. brasiliensis.*

In each of the four species of Geophagus here described, the inferior bounding fold of the inferior lip is interrupted at the middle line. The

lamelliform lobe of the first branchial arch is simple in the *G. gymnogenys*, in *G. camurus* and *G. brachyurus* its border is divided into digitate processes. In my specimen of *G. brasiliensis* the digitate processes are present but rudimental. Hensel has distinguished a species as characterized among other points by the absence of scales on the cheek. Steindachner does not appear to have met with this condition in the *G. brasiliensis*, yet he refers Hensel's species to the latter, believing that the absence of scales from the cheek is an abnormality, "probably most frequent during the spawning season." I find the character on the contrary to be constant in the eight specimens of *G. gymnogenys* and *G. camurus*, which are of different sizes and ages, and which are characterized by well-marked peculiarities of the form of the head and the body. The scales are constantly present in five specimens of the *G. brachyurus*, which are of the same size as those of the *G. gymnogenys* and *G. camurus*, and are associated with equally well-marked specific characters. I believe with Von Jhring that Hensel is right in regarding the character as of specific value.

In the *Geophagus gymnogenys* the anterior border of the orbit is as far from end of muzzle as the posterior border of the orbit is from the convexity of the opercular border. Profile nearly straight, dorsal fin not scaly at base. Cheek naked except a patch of five scales between the orbit and preopercle. Preorbital bone a little wider than tegumentary orbit. Scales $\frac{3}{28}$. Fin radii, D. XIII. 11; A. III. 8. Body deep; the depth contained in the length to base of caudal fin 2.33 times; length of head in the same, three times. Pectoral fin reaching first soft ray of anal; caudal fin openly emarginate.

Color brown, each scale with a paler centre. A dark-brown spot extends over the dorsum immediately in front of the dorsal fin and extends to the lateral line on each side. Two dark spots below the spinous dorsal fin, and two below the soft dorsal, above the lateral line. A dark spot below the lateral line behind the superior opercular angle, and another on the side below the rays xi and xii of the spinous dorsal. Dorsal and caudal fins dusky with rather numerous oval and round pale spots. A dark spot on superior part of operculum and one below eye.

Total length, 107 mm.; length to base of caudal fin, 87 mm.; length to base of anal, 53 mm.; length to base of ventral, 39 mm.; length of head side, 26 mm.

One specimen.

GEOPHAGUS CAMURUS sp. nov.

Anterior border of orbit more distant from end of muzzle than the posterior border is from convex border of operculum. Profile strongly convex at and in front of the orbit. Form most elevated at the base of the dorsal fin, then tapering posteriorly. Cheeks naked or with one or two obscure scales. Preorbital bone a little wider than tegumentary orbit.

Scales $\frac{3\frac{1}{2}}{28}$. Fin radii, D. XIV. 10; A. III. 8; two out of seven specimens with the dorsal spines XIII, and two with the soft rays of the anal 9. Caudal fin truncate. Greatest depth entering length, minus caudal fin, 2.5 times; length of head in same three times. Diameter of eye entering head three times. Pectoral fin reaching first soft ray of anal.

Color brown, each scale with a paler centre. The spotting is similar to that of the *G. gymnogenys* except that the dorsal region is dusky and without well-defined spots, the saddle shaped black spot in front of the dorsal only remaining. Below the lateral line on the middle of the side is a strongly defined spot, and traces of one behind the epiclavicle are also visible. A dark bar below the orbit, which is absent from most of the specimens, which have been somewhat bleached by alcohol. Fins spotted as in *G. gymnogenys*.

Total length, 95 mm.; length to base of caudal fin, 72 mm.; length to base of anal, 48 mm.; length to base of ventral, 26 mm; length of head on side, 24 mm.

Seven specimens. This species is near the *G. gymnogenys*, but differs much in the form of the head and body, and in the number of the rays of the dorsal fin.

GEOPHAGUS BRACHYURUS sp. nov.

Anterior border of orbit about as far from the end of the muzzle, as from the convexity of the opercular border. Preorbital bone distinctly longer than diameter of tegumentary orbit. Profile straight, slightly concave at orbit. Form of body to caudal peduncle an oblong oval. Cheeks with five rows of scales below orbit. Scales $\frac{3\frac{1}{2}}{25}$. Fin radii, D. XIV. 9; A. III. 8. In two specimens the dorsal rays are XV. 9 and XIII. 10; and in the latter specimen the anal rays are III. 9; in a thin specimen the anal rays are III. 7. Caudal fin truncate. Greatest depth entering the length, minus the caudal fin, 2.2 times; length of head entering the same 2.75 times. Diameter of eye entering side of head four times.

Color in alcohol brown, the dorsal and anal fins blackish. The color of the spinous part of the former is varied by the presence of oblique spots of a pale color, which form stripes running upwards and backwards. These transparent spots are wanting on the anal fin. A black spot at base of first dorsal rays; another below the lateral line below the middle of the spinous dorsal and a black bar below the eye.

Total length, 97 mm.; length to base of caudal fin, 75 mm.; length to base of anal, 52 mm.; length to base of ventral, 35 mm.; length of head, 28 mm.

Five specimens. This species is well distinguished from the species previously described, by the smaller eye, and an abbreviation of the body

posteriorly. The latter character reduces the number of scales of the lateral line and alters the relative proportions generally. Thus the length of the caudal peduncle equals that of the preorbital bone to the orbit; in the *G. gymnogenys* it equals the length of that bone plus the diameter of the orbit. The coloration of the fins is also peculiar.

GEOPHAGUS BRASILIENSIS Quoy and Gaimard; Steindachner, *Sitzb. K. Wien Akad.*, 1871, December, p. 13.

Anterior border of orbit considerably farther from the end of the muzzle than the posterior border is from the convex edge of the operculum. The middle of the length of the head falls near the middle of the pupil. Profile straight and steeply descending. Preorbital bone 1.75 times as long as the diameter of the orbit. Cheeks with five rows of scales. Form of body oval, a little higher in front. Scales $\frac{4\frac{1}{2}}{28}$. Fin radii, D. XV. 11; A. III. 9. Greatest depth two and one-third times in length to base of caudal fin; length of head in same two and three-quarter times. Diameter of eye entering head 4.66 times, and twice in the interorbital width, measured over its strong convexity. Caudal fin rounded, truncate in the middle, its basal portion scaly throughout.

Color light brown in alcohol, each scale with a paler centre; a large black spot below the lateral line opposite the middle of the spinous dorsal fin. A few scattered pearl blue spots on the operculum and on the scales posterior to it. Caudal fin, spinous dorsal, and base of soft dorsal dusky; the caudal with oval transparent spots and the spinous dorsal with a few oblique transparent streaks, directed upwards posteriorly. A few round transparent spots at the posterior base of the soft dorsal. Paired fins unspotted, the anterior rays of the ventrals dusky.

Total length, 193 mm.; length to base of caudal fin, 153 mm.; length to base of anal, 102 mm.; length to base of ventrals, 58 mm.; length of head, 54 mm.

This species agrees with the *G. gymnogenys* and *camurus* in its scale formula, and with the *G. brachyurus* in its scaly cheek and coloration. It differs from all of them in the more posterior position of the eye and length of preorbital bone, and in the shape of the caudal fin. In some respects it agrees with the *Geophagus macrolepis* of Günther,* but in that fish the eye has a much more posterior position. There is but one specimen of the *G. brasiliensis* in the collection.

ACARA TETRAMERA Heckel *Brasil. Fluss-Fische; Ann. der Wien Mus.*, ii, p. 341. Steindachner *Sitzber. Wien Akad.*, 1875, January, p. 5.

Numerous specimens. Dr. Steindachner having endeavored to show that the *A. flavilabris* Cope, is identical with this species, I embrace the present opportunity of making a direct comparison. With five speci-

* *Catal. Fishes Brit. Mus.*, iv, p. 314.

mens of the *A. flavilabris* before me, I find that there are but two rows of scales on the cheek, one row on the inferior limb of the preopercle, and one on the interopercle, as I have figured and described. In *A. tetramera* there are three rows on the cheek, and none on the preopercle and interopercle, as described by Steindachner. The preorbital bone is only .66 the diameter of the orbit in *A. flavilabris*, as in the younger *A. tetramera*. The front between the orbits is absolutely flat in *A. flavilabris*, while it is convex at the borders in *A. tetramera*. All the specimens of *A. flavilabris* have XVI dorsal spines. In all the lower lip is conspicuously yellow, a character not present in the *A. tetramera* in my collection, nor described by authors. The absence of this characteristic mark is the only fault in my figure.*

ACARA AUTOCHTHON Gthr. Steindachner *Sitzber. K. Wien Akad.*, 1874, December, p. 4.

SUMMARY.

The species enumerated in the preceding pages are distributed in families as follows:

	Total.	New Genera.	New Species.
Clupeidæ	1	0	0
Characinidæ	15	3	9
Sternopygidæ	2	0	0
Siluridæ	14	0	6
Symbranchidæ	1	0	0
Cyprinodontidæ	1	0	0
Cichlidæ	8	0	2
Total	42	3	17

Besides the addition of seventeen species to the fauna of the Jacuhy river, five genera are introduced. Four of these are Characinidæ, viz: Asiphonichthys, Chorimycterus, Diapoma and Pseudocorynopoma. Of these the first three are new to science, and the last has been previously known from the drainage of the La Plata only. The fifth genus is Sternopygus, which has not been enumerated by previous authors as found in the Jacuhy river.

NOTE.

Mr. Smith obtained near Chapada in Matto Grosso from the head waters of the Paraguay, *Tetragonopterus lineatus* Steind. and *T. moorei* Boul. From the head waters of the Tocantins, not far from the same locality, he obtained a species close to the *T. caudimaculatus* Gthr.

* *Proceeds. Academy Phila.*, 1872, p. 255., Pl. xi, Fig. 4.

EXPLANATION OF PLATES.

Figures all natural size unless otherwise stated.

PLATE IV.

Fig. 1. *Xiphorhamphus brachycephalus* Cope; *a*. head from above.

PLATE V.

Fig. 2. *Asiphonichthys stenopterus* Cope.
3. *Chorimycterus tenuis* Cope.
4. *Diapoma speculiferum* Cope.
5. *Tetragonopterus pliodus* Cope.

PLATE VI.

Fig. 6. *Tetragonopterus jacuhiensis* Cope.
7. *Tetragonopterus laticeps* Cope.
8. *Tetragonopterus eigenmanniorum* Cope.
9. *Chirodon monodon* Cope.

PLATE VII.

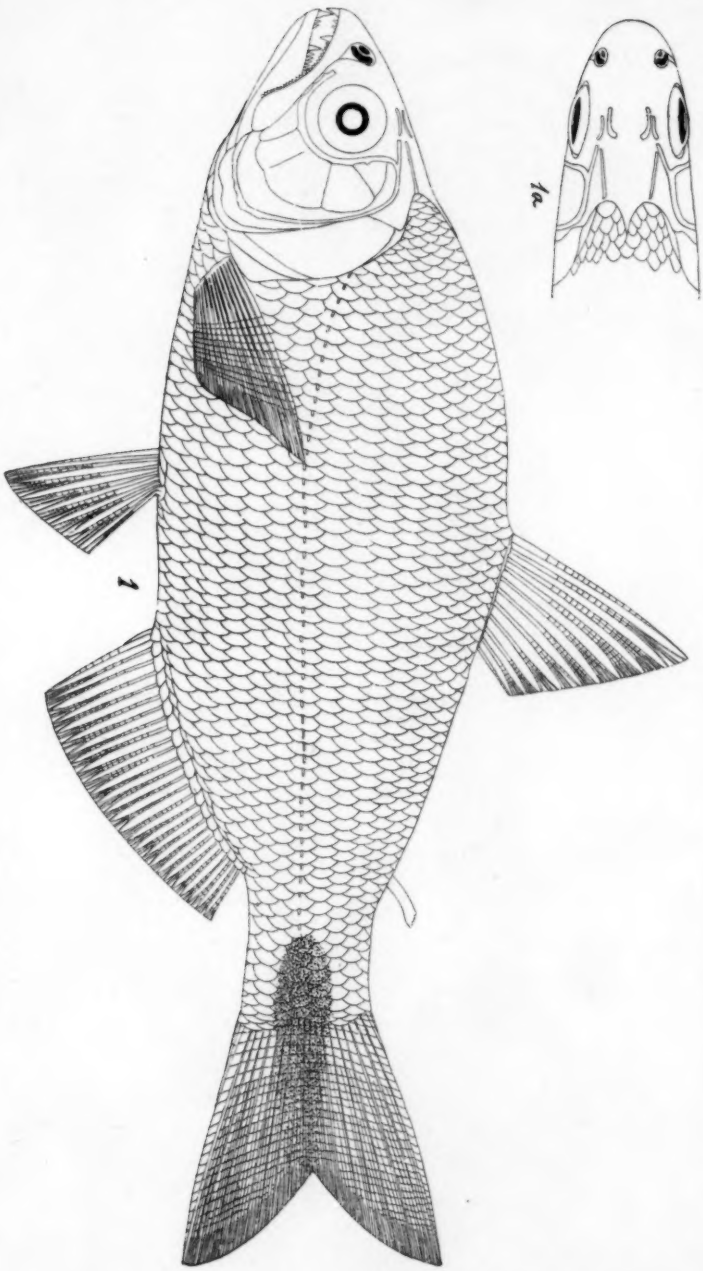
Fig. 10. *Rhamdella straminea* Cope.
11. *Hisonotus leptochilus* Cope. *a*. Head from above $\frac{3}{2}$ natural size; *b*. Head from below.
12. *Hisonotus lævior* Cope. *a*. Head from above $\frac{3}{2}$ natural size; *b*. Head from below.
13. *Otocinclus flexilis* Cope. *a*. Head from above $\frac{3}{2}$ natural size; *b*. Head from below.

PLATE VIII.

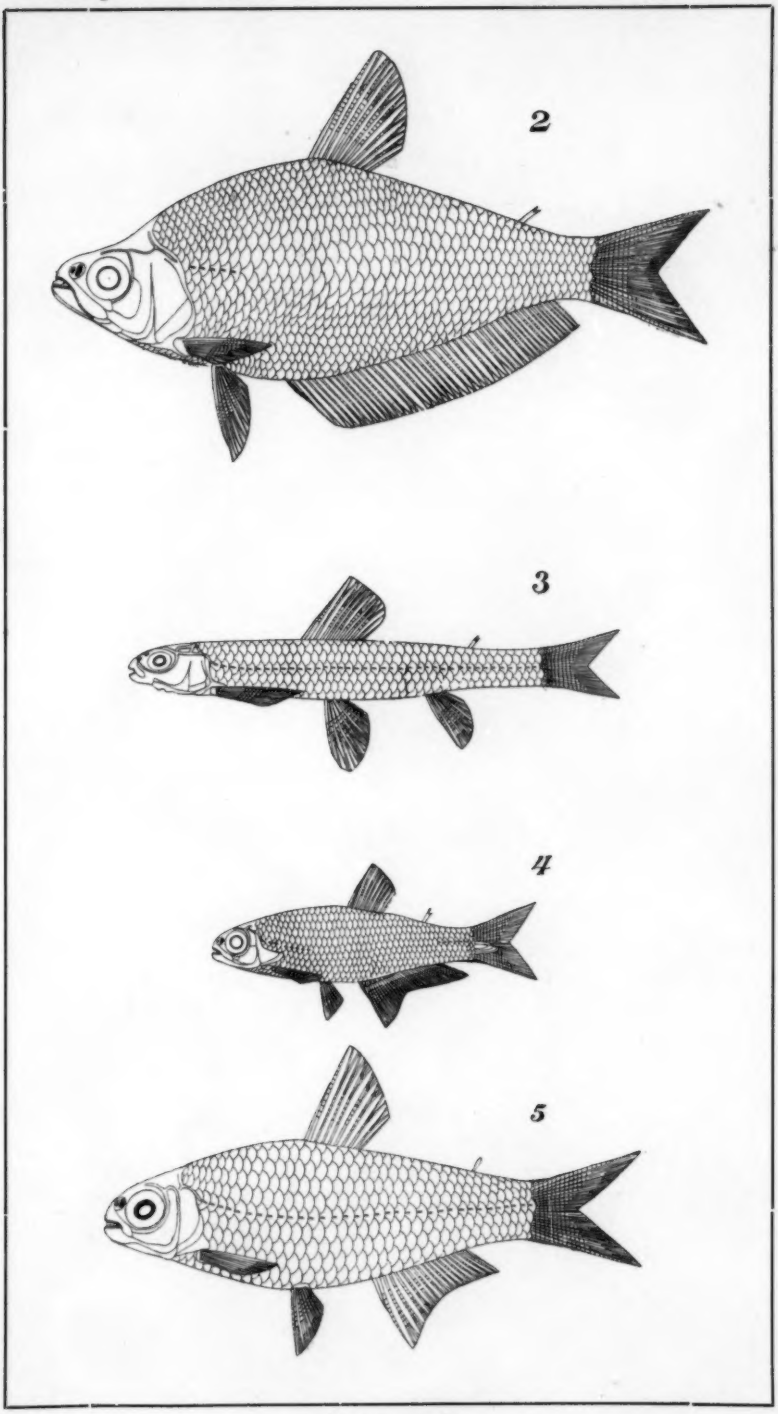
Fig. 14. *Plecostomus aspilogaster* Cope, $\frac{3}{4}$ natural size. *a*. head from below $\times \frac{3}{4}$.
15. *Loricaria cadea* Hensel, from side. *a*. From above; *b*. From below $\frac{3}{2}$ natural size.

PLATE IX.

Fig. 16. *Otocinclus fimbriatus* Cope. *a*. Head from above $\times$ 2; *b*. Head from below $\times$ 2.
17. *Geophagus camurus* Cope.
18. *Geophagus brachyurus* Cope.



Plectospondyli.



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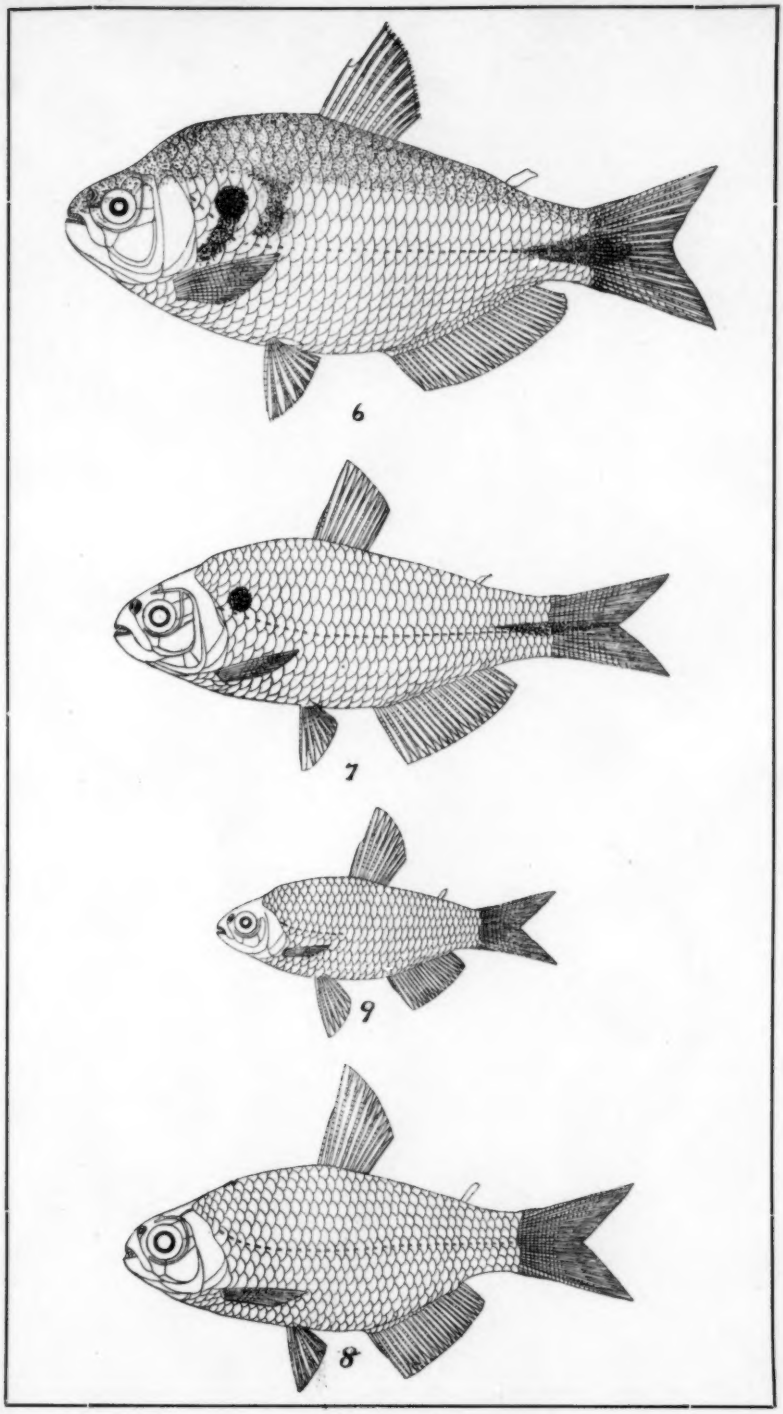
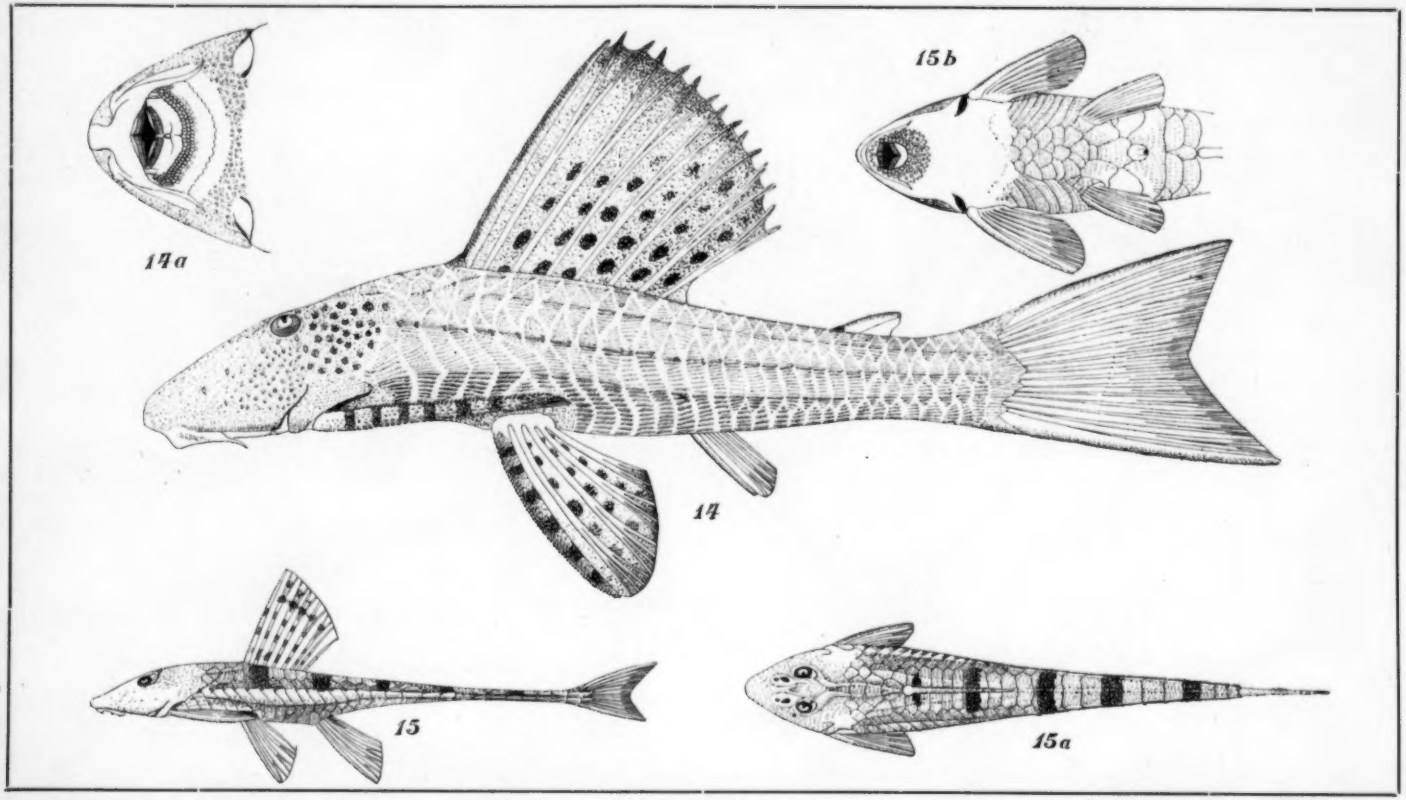
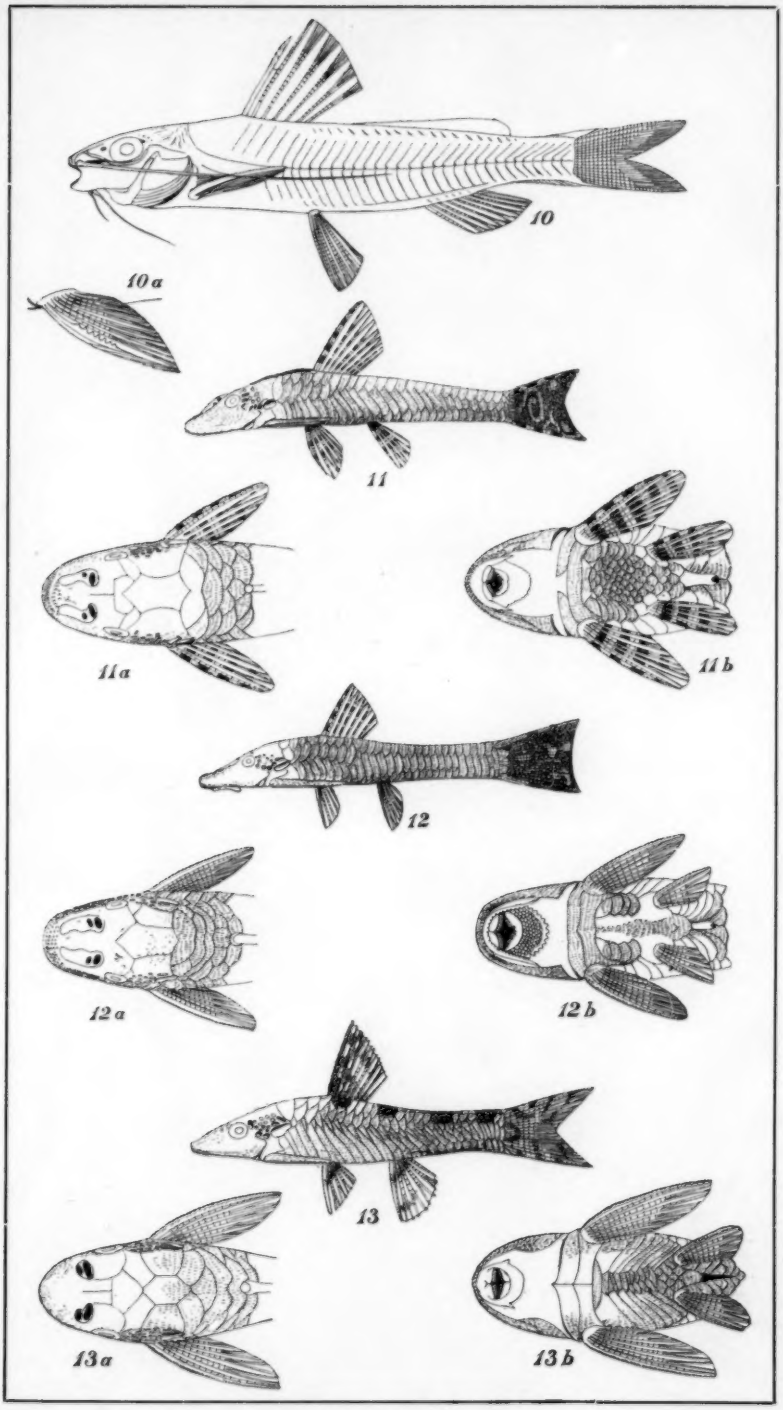


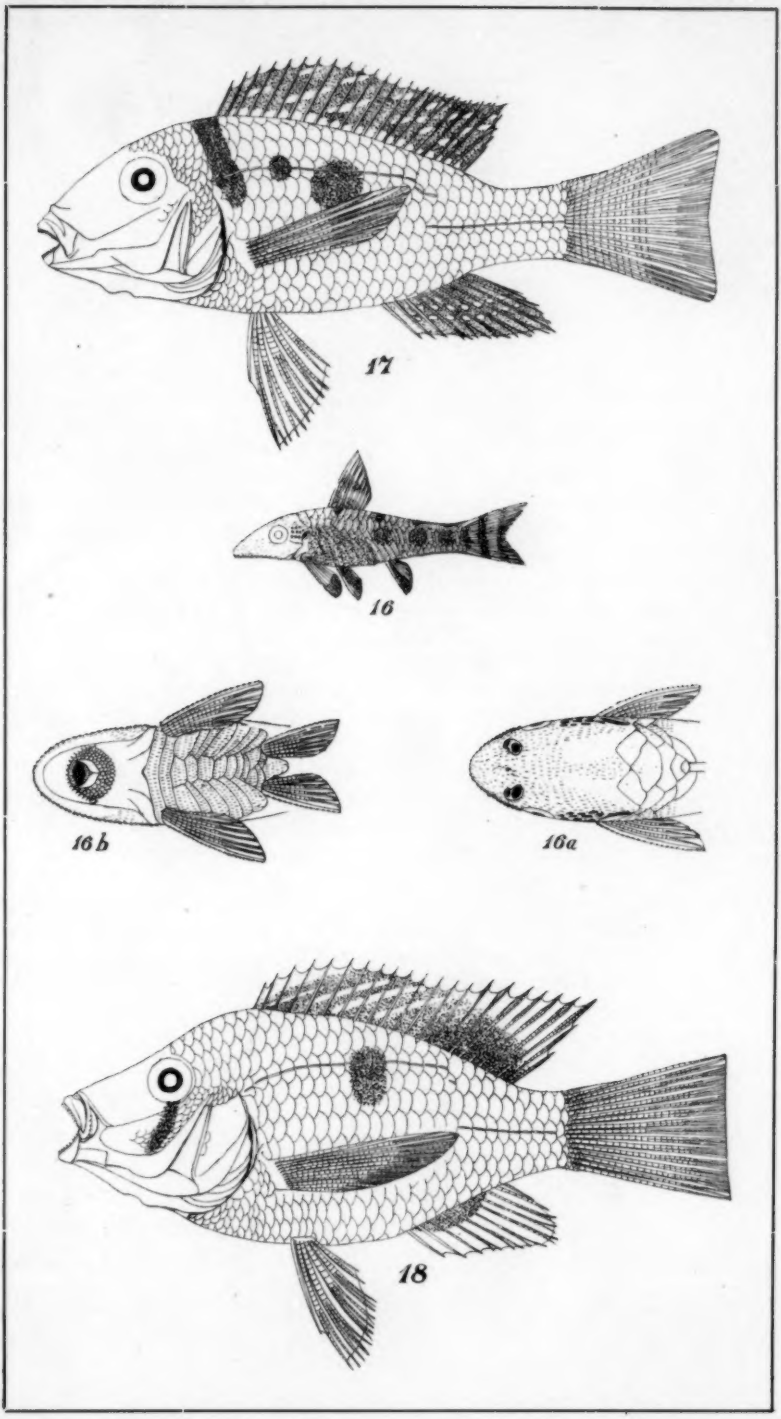
Plectospondyli.



Nematognathi.



Nematognathi.



16. Nematognathi. *17–18. Percomorphi.*

On the Structure of the Skull in the Plesiosaurian Reptilia, and on Two New Species from the Upper Cretaceous.

By E. D. Cope.

(Read before the American Philosophical Society, February 2, 1894.)

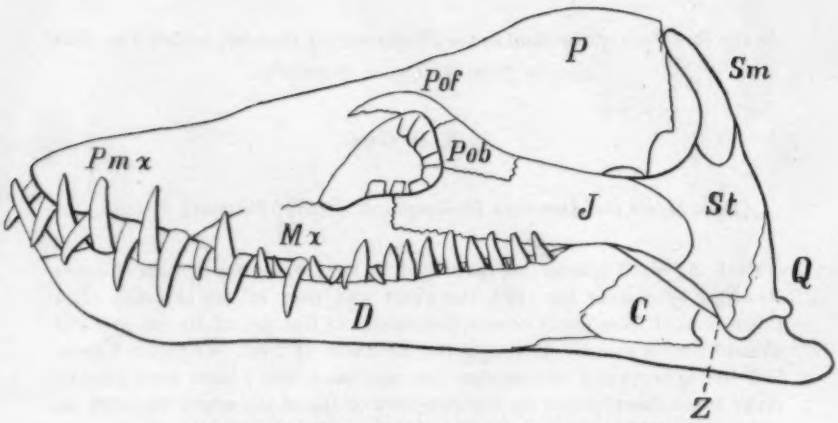
Prof. S. W. Williston has described in the *Proceedings of the Kansas Academy of Science* for 1890, the skull and part of the skeleton of a Plesiosauroid from the Niobrara Cretaceous of Kansas, under the name of *Cimoliasaurus snovii*. Through the kindness of Prof. Williston, I have had the opportunity to examine the specimen, and I have been able to make some observations on the structure of the skull, which supplies an important desideratum in our information on the subject.

In a paper in which I endeavor to trace the homologies of the cranial bars of the Reptilia,* I ascribe† to the Sauropterygia a single postorbital arch, and state that the available evidence is to the effect that this is the zygomatic. I remark, "The supratemporal has no anterior connections according to this author" (Von Meyer on Nothosaurus), "and the supramastoid is not described. From all that I can gather from Owen's figures and descriptions of Plesiosaurus, the structure is the same, which is confirmed by observation on such imperfect specimens as are accessible to me."

Examination of Williston's specimen shows that there is but one postorbital bar, and that this is partly the zygomatic, since it extends to the distal extremity of the quadrate, and encloses with it a small zygomatic or quadratojugal bone. But the posterior part of the arch includes also a large supratemporal, as in many Testudinata. Above the supratemporal, and forming the parietomastoid arch, is the separate element which I have referred to in the above quotation as supratemporal, but which it is now clear is the supramastoid. It is then homologous with the element in Ichthyosaurus and in the Cotylosauria, which I have called by that name. This discovery enables me to demonstrate the correctness of my supposition made in the paper already quoted (pp. 19–22), that the postero-lateral process of the parietal bone, so characteristic of Sphenodon and Lacertilia, really includes the supramastoid element. There is no question about the distinctness of this element from the parietal in the Cimoliasaurus, and the suture is shown in the outline figures given by Williston in his description referred to. The suture between it and the supratemporal is not so distinct, but is nevertheless visible. The following figure is copied from Williston, with the sutures inserted as I observed them.

* "On the Homologies of the Posterior Cranial Arches in the Reptilia," *Trans. Amer. Philos. Soc.*, 1892, p. 11.

† L. c., p. 21.



Posterior part of right side of skull of *Cimoliasaurus snovii* Willist.
Modified after Williston.

I embrace the present opportunity to correct an error into which I inadvertently fell when naming the elements of the cranium in the Cotylosauria, in the essay above quoted. That segment which forms the lateral angle of the superior table of the skull in the Cotylosaurian reptiles, the Stegocephalous batrachians, and many fishes, is there termed the *os intercalare*, after Cuvier. It is, however, not his intercalare, but his external occipital. This is the epiotic of Huxley, but as it is not homologous with that element in the Reptilia, it requires another name. I propose that it be called the *os tabulare*, or the tabular bone. I do not know of any reptiles other than the Cotylosauria in which it is present; (see Pl. x, *Tab.*).

I refer in this connection to a taxonomic question which depends on a correct knowledge of the posterior part of the Reptilian skull. Huxley * referred the Triassic genus Telerpeton to the Lacertilia, and I afterwards † endeavored to show that this genus, together with Rhynchosaurus, Hyperodapedon and Saurosternum belong to the Rhynchocephalia. In this I have been followed by most authors who have since treated of the subject. After a study of the cranial arches, I became convinced that these genera could not be Rhynchocephalia,‡ since they possess but one postorbital bar, while the Rhynchocephalia possess two. In the papers cited below I placed them in the Theromora in the subdivision Proganosauria, and associated with them the Proterosauriidæ. It has become evident that this is their true position, and that they are not far removed from the Anomodontia, with which they were nearly contemporary in

* *Quarterly Journ.. Geolog. Society*, London, 1869, p. 49.

† *Proceeds. Amer. Assoc. Adv. Sci.*, 1870, Vol. xix, p. 241.

‡ "Synopsis of the Families of Vertebrata," *American Naturalist*, Oct., 1889. *Syllabus of Lectures on Vertebrata Univ. of Pennsylvania*, July, 1891, p. 38.

time. It is doubtful whether the family of the Mesosauridæ on which the Proganosaurian order was founded by Baur, really belongs to this series, while the genus Procolophon Owen probably does. This genus has been regarded as the type of a group, the Procolophonina, by Seeley, and the genus Proterosaurus has been made the type of another group by the same author, under the name of Proterosauria. I have shown that the postorbital bar of the Pelycosauria (? Theriodonta) is different from that of the Anomodontia, and that the Cotylosauria (Pariasauria) is entirely distinct as an order. The Theromora as an order will then include the suborders, Placodonta, Proterosauria and Anomodonta, The problematical genera above named will all fall within the limits of the Proterosauria, as I have defined it under the name of Proganosauria.

EMBAPHIAS CIRCULOSUS, gen. et sp. nov.

Char. gen. Cervical vertebræ short, with the parapophysis and diapophysis distinct at the base and articulating freely with the centrum. Articular faces of the centra concave in the cervical and dorsal regions. Suture of neural arch with centrum, persistent.

The limbs of this genus are not certainly known. The three vertebræ on which it is established were found associated with a considerable number of the vertebræ of Elasmosaurus, and a number of bones of the arches and extremities. The proper location of the latter has not yet been made.

This is a short-necked genus, and need not be compared especially with Plesiosaurus, Elasmosaurus and Polycotylus. It differs from Uronautes, Orophosaurus and Trinacromerum in the distinctness of the basal parts of the dia- and parapophyses, and from the first two in the strong concavity of the vertebral centra. It approaches nearest in its vertebral characters to Pliosaurus, but here the dorsal vertebræ are amphiplatyan as in Plesiosaurus. I note here that the vertebral characters of Trinacromerum Cragin, as described by him,* agree with those of Orophosaurus.†

Char. specif. Cervical centrum a regular transverse wide oval, without lateral longitudinal angulation. Dia- and parapophysial facets compressed so as to be vertical, and occupying a line from near the level of the inferior face to the base of the neural arch, and fused together at their bases. The bases of the dia- and parapophyses (which are lost) were thus vertically compressed, presenting a character different from that of any Plesiosauroid known to me. On other cervicals than the single one preserved, this character may not be so pronounced, but it is not likely to have been entirely wanting on any of them. The outlines of the dorsal vertebral centra are circular, and the slightly concave sides are without angulation. The fossa for the neurapophysis is an anteroposterior oval, which does not extend over the entire length of the centrum. Arches lost, except the bases, which adhere within the fossæ. An epiphysis-like band of vertically lined surface, narrows the median longitudinally lined surface of

* *American Geologist*, 1888, p. 404; 1891, p. 171.

† *American Naturalist*, 1887, p. 564.

the middle portion of the surface of the centrum, especially at the middle line below, where it is thickened. A large foramen on each side of the middle line below, and a large one below the parapophysis in the cervical, and below the neurapophysis in the dorsal centra. Some smaller ones on the sides of the dorsals. Surfaces of the centra smooth. Neural canal narrow.

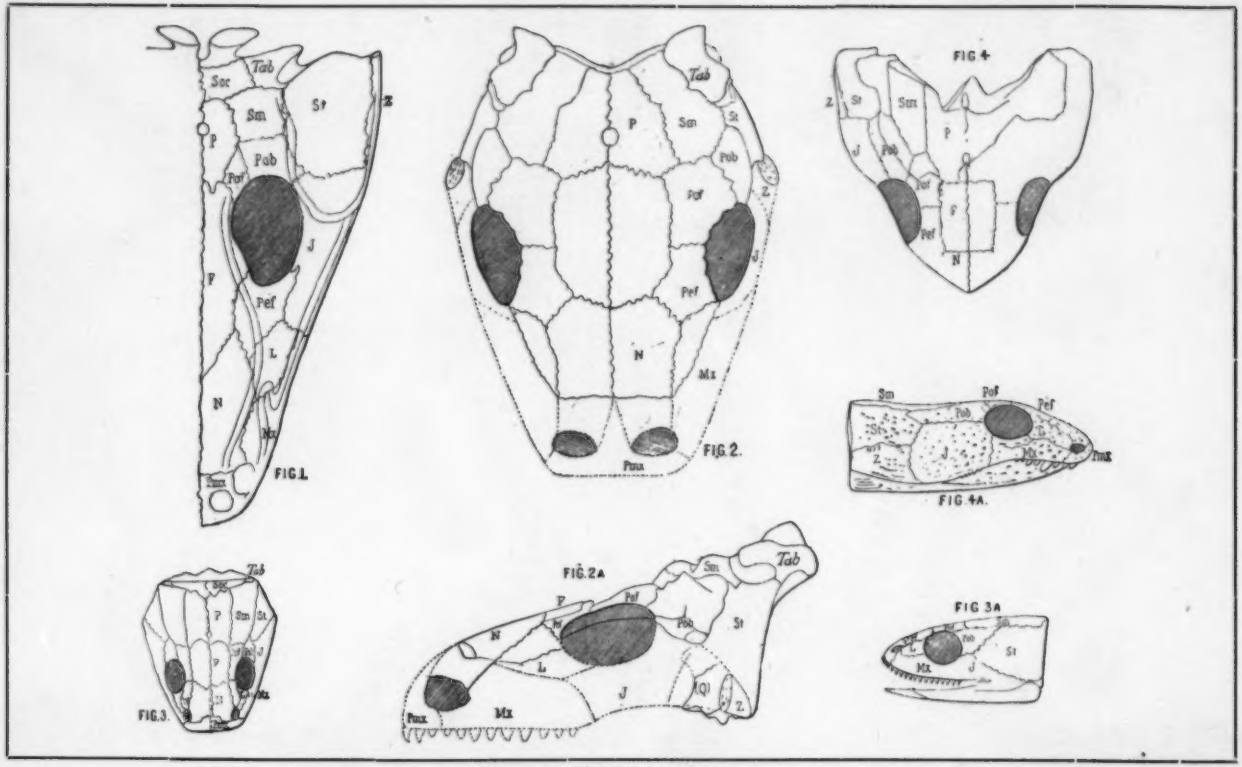
Measurements.		MM.
Diameters of cervical centrum	anteroposterior	45
	transverse	85
	vertical	76
Vertical diameter of common base of dia- and parapophysis		67
Diameters of base of parapophysis	anteroposterior	17
	vertical	36
Diameters of a dorsal centrum	anteroposterior	54
	transverse	99
	vertical	95
Width of neural canal at base		19
Depth of concavity of centrum		13

This is a species of large size, though not equal in dimensions to the known species of Elasmosaurus. It was found in the upper Cretaceous bed of the Pierre epoch, at the Big Bend of the Missouri river in South Dakota. It was presented to the Academy of Natural Sciences by Mr. John H. Charles, of Sioux City, together with the remains of Elasmosaurus below mentioned. I wish to express my sense of the obligation under which Mr. Charles has placed the Academy and myself by his liberality in this and other matters.

ELASMOSAURUS INTERMEDIUS, sp. nov.

Established on a series of nineteen vertebræ of the cervical and anterior dorsal regions of an individual from the Pierre formation of South Dakota.

The vertebral centra are the shortest known in the genus, approaching the Cimoliasaurus in proportions. The median and anterior cervicals display the compressed form characteristic of Elasmosaurus, although they are shorter than in the three known species of that genus. The posterior median cervical vertebræ are depressed, but the centra of the posterior members of that series are less depressed, and they increase in length less rapidly than they do in depth. They are shorter absolutely and relatively than in the *E. orientalis* Cope, to which this species is most nearly related. In the anterior dorsals the depth exceeds the length of the centrum, while in the *E. orientalis* the depth is about two-thirds the length. The cervicals exhibit an angle of the lateral surface about half way between the diapophysis and neurapophysis. The angle disappears on the anterior dorsals. The superior and inferior outlines of the articular faces are not emarginate or concave medially, which they are in the *E. orientalis*.



Stegocephali and Cotylosauria.

The lateral walls of the centra near to the articular faces are marked with strong rather sharp ridges, which are separated by grooves of several times their width.

Measurements.		MM.
Diameters of an anterior cervical	anteroposterior	55
	transverse	44
	vertical	45
Diameters of a median cervical	anteroposterior	76
	transverse	70
	vertical	65
Diameters of a posterior cervical	anteroposterior	78
	transverse	107
	vertical	88
Diameters of an anterior dorsal	anteroposterior	74
	transverse	96
	vertical	90

The specimen was found with that of the *Embaphias circulosus* at the Big Bend of the Missouri in South Dakota, and was presented to the museum of the Academy of Natural Sciences by Mr. John H. Charles, of Sioux City, Ia.

ELASMOSAURUS sp.

Prof. N. H. Winchell sent me for examination a portion of the vertebral column of a Plesiosauroid from the Niobrara Cretaceous of Dakota (exact locality not known), which consists of forty-three centra and portions of the arches and limbs. It is one of the shorter-necked forms of the genus, resembling the *E. intermedius* in the proportions of its cervical vertebræ. The dorsals are relatively larger, but they are all, with most of the cervicals, so distorted by pressure that it is impossible to characterize the species.

EXPLANATION OF PLATE.

Permian and Triassic Cotylosauria and Stegocephali:

Fig. 1. *Mastodonsaurus giganteus* Jaeger; $\frac{1}{15}$ nat. size; from the Trias of Germany. From Fraas.

Fig. 2. *Chilonyx rapidens* Cope; $\frac{3}{15}$ nat. size; from the Permian of Texas.

Fig. 3. *Pariotichus megalops* Cope; nearly nat. size; from the Permian of Texas.

Fig. 4. *Pantylus cordatus* Cope; nearly half nat. size; from the Permian of Texas.

Lettering.

Tab., Os tabulare; *Soc.*, Supraoccipital; *Sm.*, Supramastoid; *St.*, Supratemporal; *Z.*, Zygomatic (quadratojugal); *Pob.*, Postorbital; *Pof.*, Postfrontal; *P.*, Parietal; *F.*, Frontal; *Pef.*, Prefrontal; *J.*, Jugal; *Q.*, Quadrate; *L.*, Lachrymal; *Mx.*, Maxillary; N., Nasal; *Pmx.*, Premaxillary.

PROC. AMER. PHILOS. SOC. XXXIII. 144. O. PRINTED MARCH 24, 1894.

Forests of Pennsylvania.

By J. T. Rothrock, Botanist Member of the Pennsylvania Forestry Commission.

(*Read before the American Philosophical Society, March 2, 1894.*)

Exact statistics as to the forest area are as yet not available for the State of Pennsylvania. It is true that we can speak with some certainty of the area of our State which is devoted to farming interests. Deducting this from the known area of the State would, however, still leave us very wide of an exact statement as to the area actually covered by a growth of wood which is now, or ever will be, productive forest land. There would remain unaccounted for the space covered by cities, towns and villages; by mines, where the surface is allowed to remain unutilized because the wealth below dwarfs its importance, and because the surroundings are not favorable to production of trees; and lastly there would remain the fact that an enormous percentage of the reputed woodland is now producing timber of the slowest growing and least valuable kinds of wood, if indeed it should be designated as wood at all. It will be, however, an approximate statement, based upon the reports of our assessors for the year 1892, to say that we have accounted for 16,359,387 acres of cleared land, and 9,159,826 acres of woodland. This will at least fairly represent farming land, and the area covered by woody growth of some kind, and may afford a basis for computation as to the condition of things which *should* exist. By the above statistics we may account for about 25,555,500 acres of farm and woodland. This, however, leaves from four to six millions of acres of our State area to be accounted for as coming neither under farming nor forest conditions at present. Nominally we have nearly 36 per cent. of our area in trees, if we accept our assessors' statements as a basis of calculation.

For convenience sake this paper will be divided thus:

I. The Kinds of Timber-producing Trees in Pennsylvania.
II. Most Important Timber-producing Areas in Pennsylvania.
III. Configuration of the State in Relation to Growth of Timber.
IV. Rates of Growth of Most Important Kinds of Timber.
V. Obstacles to the Growth of Timber.
  (*a*) Natural Obstacles.
  (*b*) Obstacles due to Human Agencies.
VI. Relation of the Commonwealth to Forest Restoration.
VII. Methods of Forest Restoration.

I. The Kinds of Timber-producing Trees in Pennsylvania.

The list of such trees indigenous to our State, which are of sufficient size, or in sufficient abundance to be of commercial importance, numbers seventy-eight species and is as follows:

3 Magnolia glauca L. ..... Sweet bay, or swamp laurel.
2 Magnolia acuminata L. ..... Cucumber tree.
3 Magnolia tripetala L. ..... Umbrella tree.
1 Liriodendron tulipifera L. ..... Tulip poplar.
2 Tilia Americana L. ..... Basswood.
2 Tilia heterophylla Vent. ..... White basswood.
3 Ilex opaca Ait. ..... American holly.
3 Ilex monticola Gray. ..... Mountain holly.
3 Æsculus octandra Marshall. ..... Sweet buckeye.
3 Æsculus glabra Willd. ..... Ohio buckeye.
3 Acer Pennsylvanica L. ..... Striped maple.
1 Acer saccharinum Wang. ..... Sugar maple.
2 Acer dasycarpum Ehrh. ..... White, or silver maple.
2 Acer rubrum L. ..... Red, or swamp maple.
3 Negundo aceroides Mœnch. ..... Box elder.
3 Rhus typhina L. ..... Staghorn sumach.
1 Robinia pseudacacia L. ..... Locust.
3 Gymnocladus Canadensis Lam. ..... Kentucky coffee tree.
3 Gleditschia triacanthos L. ..... Honey-locust.
3 Prunus Americana Marshall. ..... Wild yellow, or red plum.
3 Prunus Alleghaniensis Porter. ..... Allegheny plum.
3 Prunus serotina Ehrh. ..... Wild black cherry.
3 Pyrus coronaria L. ..... Crab apple.
3 Pyrus Americana DC. ..... American mountain ash.
3 Cratægus coccinea L. ..... Scarlet haw, or whitethorn.
3 Cratægus punctata Jacq. ..... Blackthorn, or pear haw.
3 Cratægus Crus-galli. ..... Cockspur, or Newcastle thorn.
3 Liquidambar Styraciflua L. ..... Sweet-gum tree, or bilsted.
3 Cornus florida L. ..... Dogwood, or flowering dogwood.
3 Cornus alternifolia L., f. ..... Alternate-leaved dogwood.
2 Nyssa sylvatica Marshall. ..... Sour-gum, tupelo, pepperidge.
3 Oxydendrum arboreum DC. ..... Sorrel-tree, sour-wood.
2 Diospyros Virginiana L. ..... Persimmon.
1 Fraxinus Americana L. ..... White ash.
2 Fraxinus pubescens Lam. ..... Red ash.
2 Fraxinus viridis Michx., f. ..... Green ash.
2 Fraxinus sambucifolia Lam. ..... Black, hoop, ground, or water ash.
3 Chionanthus Virginica L. ..... Fringe tree.
2 Catalpa bignonioides Walt. ..... Catalpa, Indian bean, cigar tree.

This tree is not a native of Pennsylvania, but is becoming rapidly and generally naturalized, and is likely to be of considerable importance. For this reason I have included it in my list.

2 Sassafras officinale Nees. ..... Sassafras.
2 Ulmus fulva Michx. ..... Slippery elm, red elm.
1 Ulmus Americana L. ..... White elm, American elm.

2 Celtis occidentalis L.....Hackberry, nettle tree.
2 Morus rubra L.....Red mulberry.
2 Platanus occidentalis L.....Buttonwood, sycamore.
2 Juglans cinerea L.....Butternut, white walnut.
1 Juglans nigra L.....Black walnut.
1 Carya alba Nutt.....Shellbark, or shagbark hickory.
2 Carya sulcata Nutt.....Big shellbark, king nut.
1 Carya tomentosa Nutt.....White-heart hickory, mocker nut.
1 Carya porcina Nutt.....Pig-nut, or broom hickory.
2 Carya amara Nutt.....Swamp hickory, or bitternut.
2 Betula lenta L.....Cherry, sweet, or black birch.
2 Betula lutea Michx. f.....Yellow, or gray birch.
2 Betula populifolia Ait.....White birch.
2 Betula papyrifera Marshall.....Paper, or canoe birch.
2 Betula nigra L.....Red, or river birch.
3 Ostrya Virginica Willd.....Hop-hornbeam, leverwood.
3 Carpinus Caroliniana Walter.....Hornbeam, blue, or water beach.
1 Quercus alba L.....White oak.
2 Quercus stellata Wang.....Post, or iron oak.
2 Quercus macrocarpa Michx.....Bur oak, overcup oak.
2 Quercus bicolor Willd.....Swamp white oak.
1 Quercus Prinus L.....Chestnut oak, rock chestnut oak.
1 Quercus Muhlenbergii Engelm.....Yellow oak, chestnut oak.
1 Quercus rubra L.....Red oak.
1 Quercus coccinea Wang.....Scarlet oak.
1 Quercus coccinea var. tinctoria Gray.Black, or yellow-barked oak.
2 Quercus palustris Du Roi.....Swamp, or pin oak.
3 Quercus falcata Michx.....Spanish oak.
3 Quercus nigra L.....Black jack, or barren oak.
3 Quercus imbricaria Michx.....Laurel oak, shingle oak.
3 Quercus Phellos L.....Willow oak.
1 Castanea sativa Mill. var. Americana Gray.....Chestnut.
3 Castanea pumila Mill.....Chinquapin.
2 Fagus ferruginea Ait.....Beech.

There appears to be no native willow of sufficient importance to merit a place in this list.

1 Pinus Strobus L.....White pine.
1 Pinus rigida Miller.....Pitch pine.

Under the pitch pine the Pennsylvania lumberman groups what he recognizes as yellow and jack pine.

2 Pinus pungens Michx., f.....Prickly pine, poverty pine, table mountain pine.
2 Pinus inops Ait.....Jersey, or scrub pine.

3 Pinus mitis Michx.....Short-leaved yellow pine, yellow pine.
2 Pinus resinosa Ait.....Norway pine, red pine.
2 Picea nigra Link.....Black spruce.
1 Tsuga Canadensis Carr.....Hemlock.
2 Abies balsamea Miller.....Balsam, balsam fir.
2 Larix Americana Michx .....Hackmatack, larch, tamarack.
2 Thuya occidentalis L.....Arbor vitæ.

The above trees I have divided into a first, second and third class, and designated the class by a corresponding figure to the left of the name. Commercial importance and abundance are made the basis of this artificial classification: the only merit of which is that it will serve to impress certain leading facts.

The nomenclature adopted is that of Gray's *Manual of Botany*, which will remain the popular authority until superseded by a more modern book.

II. Most Important Timber-producing Areas in Pennsylvania.

The words, "most important" timber-producing areas, are, of course, in one sense, relative, because they carry a twofold meaning, *i. e.*, important as to quantity produced, and important as to the uses made of each kind of wood. In one sense we might consider hemlock and white pine the most important for Pennsylvania; because the former is a characteristic tree of our State, and the latter one of immense commercial importance. We shall, however, use the words more especially in regard to the quantities produced on land which may be regarded as by nature better adapted to the growth of timber trees than to any other purpose.

This would naturally suggest the mountain areas of the Commonwealth. It must be remembered, however, that an exclusive consideration of these regions would practically exclude the soil on which our best white oak, black walnut, ash, tulip poplar and linden have grown. Furthermore, land now of more value for agricultural purposes than for any other uses might by some change in price of crops, or by other commercial perturbations, be ultimately found of greater value in production of some quick-growing kind of timber. This chance is quite within the limits of possibility in the case, for example, of the chestnut tree, if the fruit should ever become, as in Southern Europe, an important article of food and a stimulus be given to the production of choice varieties of the tree. Indeed it is by no means certain that we shall not very soon have an example in the increased demand for young chestnut as a source of supply for tannin.

Extending northeast from the southern border of the State through the central third is a region of varied topographical characters. Much of it is mountainous and rocky, and but for the possible discovery of mineral resources, and those already known, is of no value except for the growth of timber. The actual area of the land of this character is not yet

accurately determined, though it will probably aggregate not less than 5000 square miles. Once the timber is removed from such land, under present conditions it becomes not only an unproductive area to the State, but too frequently a nursery of floods during the time of melting snows and in periods of unusual rainfall. The Commonwealth has, therefore, a double inducement to restore it to its normal condition, either by direct care, or by such wise legislation as will enable the owners to do so.

What this legislation will, or, should be, depends very largely on the condition of the owners of this timber-producing area. For example, in the State of New York the mountain areas—Adirondacks and Catskills—are comparatively isolated. State possession there seems not only the probable, but the natural thing, when one considers that these same mountain regions are most important as water sheds for the eastern parts of that Commonwealth.

On the contrary, in this State the mountain areas are quite too large to encourage the idea that they ever will, or ever should, become the property of the State. In short, they will most likely remain in the hands of the small land holder, and the legislation intended for such areas must, from the nature of the case, be chiefly adapted to his needs.

Considering the counties of the State alphabetically, it appears that the cleared and the forest acreage of the Commonwealth is as follows:

Table Showing what Percentage of the Entire Acreage of Each County is Timber Land.

Counties.	Cleared Land.	Timber Land.	Entire Acreage.	Per cent.	Classification.			
					% 25	% 50	% 75	100
1 Adams	251,637	55,571	307,208	18	18			
2 Allegheny	22,422							
3 Armstrong	296,111	87,713	383,824	22.8	22.8			
4 Beaver	196,616	59,214	255,830	23.1	23.1			
5 Bedford	330,059	234,277	564,536	41.5		41.5		
6 Berks	430,516	82,790	513,306	16	16			
7 Blair	141,997	154,292	296,289	52			52	
8 Bradford	468,350	204,131	672,481	30.3		30.3		
9 Bucks	350,364	19,151	369,515	5.2	5.2			
10 Butler	365,672	103,528	469,200	22	22			
11 Cambria	322,394	73,507	395,901	18.5	18.5			
12 Cameron	34,072	189,381	223,453	84.7				84.7
13 Carbon	82,646	109,744	192,390	57			57	
14 Centre	189,580	124,107	313,687	39.5		39.5		
15 Chester	389,306	52,474	441,780	11.2	11 2			
16 Clarion	284,471	75,378	359,849	20 9	20.9			
17 Clearfield	177,227	477,978	655,205	72 9			72 9	
18 Clinton	148,957	405,881	554,838	73.1			73.1	
19 Columbia	186,808	100,426	287,234	34.9		34.9		
20 Crawford	425,103	180,600	605,703	29.8		29.8		
21 Cumberland	231,161	40,057	271,218	14.7	14.7			
22 Dauphin	213,768	102,972	316,740	32.5		32 5		

Counties.	Cleared Land.	Timber Land.	Entire Acreage.	Per cent.	Classification.			
					% 25	% 50	% 75	100
23 Delaware	110,000	11,500	121,500	9.4	9.4			
24 Elk	107,611	395,420	503,031	78.6				78.6
25 Erie	403,722	47,264	450,986	10.4	10.4			
26 Fayette	302,274	157,565	459,839	34.2		34.2		
27 Forest	139,501	138,393	277,894	49 8		49.8		
28 Franklin	291,044	134,250	425,294	31.5		31.5		
29 Fulton	114,172	182,636	296,808	61.4			61.4	
30 Greene	341,607							
31 Huntingdon	259,416	229,390	488,806	46.9		46.9		
32 Indiana	342,455	138,916	481,371	28.8		28.8		
33 Jefferson	200,565	187,985	388,550	48.3		48.3		
34 Juniata	139,182	77,122	216,304	35.6		35.6		
35 Lackawanna	237,622	31,796	269,418	11.8	11 8			
36 Lancaster	512,169	57,148	569,317	10	10			
37 Lawrence	186,793	19,221	206,014	9.3	9.3			
38 Lebanon	173,692	38,941	212,633	18 3	18.3			
39 Lehigh	185,620	16,492	202,112	8 1	8.1			
40 Luzerne	300,000	382,400	682,400	56			56	
41 Lycoming	400,000	306,000	706,000	43.3		43.3		
42 McKean	387,088	230,371	617,459	37.3		37.3		
43 Mercer	361,666	39,670	401,336	9.8	9.8			
44 Mifflin	138,155	135,325	273,480	45.8		45.8		
45 Monroe	152,100	170,810	322,910	52.8			52.8	
46 Montgomery	269,582	12,044	281,626	4.3	4.3			
47 Montour	59,811	15,314	75,125	20.4	20.4			
48 Northampton	189,591	21,448	211,039	10.2	10.2			
49 Northumberland	184,556	82,223	265,779	30.6		30.6		
50 Perry	150,817	149,658	300,475	49.8		49.8		
51 Philadelphia	80,000	3,000	83,000	3.6	3.6			
52 Pike	25,053	318,472	343,525	92.7				92.7
53 Potter	125,951	552,939	678,890	81.4				81.4
54 Schuylkill	400,000	137,600	537,600	25.6		25.6		
55 Snyder	132,303	66,322	198,625	33.4		33.4		
56 Somerset	291,081	278,223	569,304	48.8		48.8		
57 Sullivan	121,472	147,881	269,353	54.9			54.9	
58 Susquehanna	316,801	159,231	476,032	33.4		33.4		
59 Tioga	372,345	259,356	631,701	41		41		
60 Union	101,437	79,062	180,499	43.8		43.8		
61 Venango	188,658	166,096	354,754	46.8		46.8		
62 Warren	250,314	174,671	424,985	41.1		41.1		
63 Washington	422,637	64,119	486,756	13.1	13.1			
64 Wayne	399,905	26,720	426,625	6.2	6.2			
65 Westmoreland	420,832	148,680	569,512	26.1		26.1		
66 Wyoming	100,337	122,642	222,979	55			55	
67 York	430,213	112,338	542,551	20.7	20.7			

Résumé.

2 counties not fully reported.
25 " have less than 25 per cent. of timber land.
27 " " more " 25 " " less than 50.
9 " " " " 50 " " " " 75.
4 " " " " 75 " "

Cleared land.....16,359,387 acres.
Timber " ..... 9,159,826 "

Total.....25,519,213 "

25,519.) 9,159,826 (35.9% nearly,
or 9-25 nearly.

Thirty-five 9-10% of the land reported in timber.

From the above it will be seen that there are fifty-two counties whose area of timber land is less than fifty per cent. of that of the county. There are of these, seventeen whose area is less than twenty per cent. of the entire area of the county.

On the other hand, there are four counties where the area remaining in timber is at least seventy-five per cent. of the entire acreage of the county.

The assessors' reports do not represent the entire acreage of the counties as a rule. They are also faulty, or rather misleading, because much of what is there classified as timber land is not such in any present productive sense. Union and Mifflin counties are good illustrations. This remark is not designed to cast any discredit on their work. There are good reasons why they could make no nearer approach to an exact statement, and the wonder is that they have done so well. From four of the counties no exact report has been had. It is quite clear that of this thirty-five per cent. not less than one-fourth is producing nothing that should be called timber.

III. Configuration of the State in Relation to the Growth of Timber.

In the present condition of affairs, in this Commonwealth, it is safe to assume that land which is too poor to yield remunerative crops had better be devoted to the growth of something else than the growth of cereals, or to put the proposition more broadly, agriculture on such ground does not pay. To this one may add another proposition which comes partly as a sequence of the first: *i. e.*, that land so steep as to be farmed at a disadvantage, unless it is specially adapted to grazing, tending to become impoverished by the washing away of the elements of fertility, and requiring constant restorative measures, is not remunerative under ordinary agriculture and therefore should be restored to growth of timber. It is to be observed that these statements are made not as a basis for any State interference, but merely as suggestions for the individual land owner.

The most important timber trees of this State are white pine, hemlock,

white oak, rock oak, pitch pine, shellbark and pignut hickory, black walnut, locust and chestnut. Of these the white pine is a tree of wide geographical range, and of equally wide powers of adaptation to conditions of soil and climate. Originally it grew more or less commonly through the State from the northern to the southern boundary, and most abundantly along the central meridian. It is especially noteworthy that though its favorite locality was on the higher, poorer soils, where, when once cleared, the land had little agricultural value, that it still grew luxuriantly on some of the lower, richer lands. What the original rate of reproduction over most of its area was cannot now be answered with certainty. It is, however, safe to say that on the soil best adapted to its growth in the central part of Pennsylvania, one may expect to see a tree of this species grow in from fifty-five to sixty-five years to a diameter at two feet above the ground of from eighteen to twenty-two inches. Such timber is not mature. An inspection of the stump of one felled at this age will reveal the fact that the tree was then in the most productive period of its growth, and hence that it was poor policy to sacrifice it then.

The hemlock prefers the rocky sides of our mountain gorges, or a rocky hillside overlooking a stream. Occasionally it appears in a deep forest on a flat by a stream. It is very scarce along the southern border of the State except in the mountains proper, where it extends its range to the south.

If it were required to select a single tree which should be peculiarly representative of Pennsylvania the hemlock would probably most fully be so. Here to a greater extent than in any other State it has been an important tree in our lumbering interests, and no less important in the manufacture of leather. Here also its most reckless destruction has been witnessed; where miles of matured hemlock forest have been absolutely sacrificed for the bark alone. In this State also there are probably more miles suited to reproduction of hemlock than in any other Northern State. In some respects the hemlock is peculiar; for example, the nurseryman finds no great trouble in raising it, growing it into hedges or even into isolated trees. Yet the experience of our lumbermen and the few who have tried to restore it as a forest tree has not been encouraging. Of course there are reasons for the different results, mainly due to the fact that the forester works under conditions which are inimical to its growth and which, to a large extent, the nurseryman can avoid. Still the fact remains that the hemlock is among the slowest of our forest trees in its early growth, and when the shade under which it originally grew is destroyed the difficulties of its reproduction are immensely increased. It is, however, of the utmost importance to the Commonwealth that its restoration be attempted, first, because of its intrinsic value; second, because it grows and thrives on land which, but for it, would be almost valueless. The hemlock is, as a rule, a tree having but little tap root. Its roots spread out along or just beneath the surface of the soil. Yet as one of the biological marvels connected with this wonderful tree, it will often be

found attaining its most vigorous growth and size on a rocky hillside where there is almost no soil in sight. Of course it is clear that under such conditions it must have departed from its usual rule and sent its roots deeply down beneath the surface.

The white oak would probably come next in popular esteem. It is, however, fairly a question whether the rock oak is not of greater commercial importance to this State. The best white oak, as regards both strength and durability, contrary to the general opinion, comes from the rich alluvial lands. To the truth of this proposition both science and the most intelligent experience testify. Probably of all our important forest trees, no species is more readily grown than the white oak. Mere altitude (so far at least as our State is concerned) appears to be no obstacle to its growth. We find it at the level of tide and also at an elevation of two thousand feet and upwards. It will flourish along the mountain sides, then suddenly disappear as you reach the steeper, rocky slopes, where the rock oak by its abundance gives character to the forest. It can hardly be supposed that altitude alone has been the determining cause of its disappearance. The statement has already been made that white oak from higher, poorer soil was of inferior quality, and this may indicate such a lack of physical vigor as makes it unable to cope with the hardier rock oak and locust which abound on such situations. Some of the most thrifty young white oak groves I have found in this State have been between the altitudes of one thousand and seventeen hundred feet above the sea level. In such situations the soil, however, was loamy, and with so few rocks that, once cleared, it might well enough have served for agricultural purposes. On the mountain slopes, just at the foot of the steeper incline, where there is an accumulation of loam washed from the heights above, the growth of white oak is often the most vigorous. This fact seems to obtain in our State without regard to altitude, and points again to the conclusion that for the most successful growth of this species, a fertile, comminuted soil is of the first importance.

Rock oak, locust and chestnut form, in one sense, a group by themselves—that is they agree markedly in certain peculiarities of habit, being always found associated under certain conditions, and yet on the other hand each able to thrive under conditions which would be inimical to the best development of the other. For example, they all may be expected to grow in association along those mountain slopes where the Medina and Oneida sandstones appear; neither altitude nor the rocky masses seem to prevent their growth. Yet the limestone almost certainly exercises a limiting influence on the chestnut and possibly on the rock oak, while the locust often becomes a very large tree on limestone soil.

The pitch pine may be regarded as a tree of pliant constitution. Its most constant home is on the higher mountain areas of the State. It is, however, to be observed that the reason why it now appears most frequently there is simply because it has been largely extirpated from all

other sites. The mountain tops are its remaining strongholds. It is, however, also found growing in the sands of the seashore.

The hickories (shellbark and pignut) are trees of lower ground. The former seldom leaves the alluvial flats, and though the latter is often found on the higher grounds, it seldom reaches the mountain top. Were it not for the fact that Eastern North America is the only natural home of our most valuable hickories it would hardly be worth while, or fair, to place them among our most important trees. In fact their approaching scarcity in connection with their easy reproduction is their strongest claim to notice here. As a rule all the species of hickory demand a good soil—even though it may be on a hilly surface.

Black walnut has been of importance. It is practically exhausted now. During the season's travel I have seen almost none remaining that was fully matured.

The white walnut grows along streams even high up on the mountain side, but the black walnut seldom is found in a thriving condition among the rocks of the higher, steeper slopes. This tree (black walnut) appears to grow equally well on limestone soils and on alluvial flats. Though it seems to be as averse to the Oneida and Medina sandstone regions as the rock oak, chestnut and locust are partial to them.

IV. Rates of Growth of Most Important Kinds of Timber.

The rates of reproduction and of growth in this country are both a surprise to a foreign forester. It is with the latter of these that we are chiefly concerned, for the mere reproduction of seedlings is, as a rule, so vastly in excess of what the ground can support that the question is narrowed down to rate of growth of the surviving trees.

It is fair to lay down the general propositions that growth in height of our more important species is mainly a question of environment, and that wood production attains its yearly maximum about the close of the second third of the average life of the tree.

The first of these important propositions bears probably less upon the weight of the adult tree than it does on the character of the main trunk and on the spreading of the more important branches; in other words, that the towering white pine, white oak, or tulip poplar which has grown up in a dense forest has probably about the same quantity of wood in it that the more spreading specimens of the same species would have when grown in more open ground.

To illustrate the importance of the second proposition, that the maximum wood production is about the close of the second third of the tree's life, let us for a moment consider the relative values of one-fourth of an inch of new wood around a stem whose diameter is six inches and one whose diameter is twenty-four inches, the proportion would be as eighteen is to seventy-two, or to reduce it to a decimal, the annual wood production of the smaller stem would be but twenty-five per cent. of the larger.

There is no species of tree whose rate of growth is independent of environment. In Germany fifty cubic feet of wood is reckoned a large annual production for an acre. In this country there are abundant facts to prove that from one hundred to one hundred and twenty-five cubic feet is not unusual for the same time and on a like area.

To bring the question to a more practical presentation, it is fair to say that the average annual growth of a white oak on our mountain sides is between one-sixteenth of an inch and one-eighth. A tree of the same species growing on the alluvial flats of the lower Delaware or Susquehanna would show an average year's growth of from one-eighth to one-fourth of an inch. The rock chestnut oak on the rocky side of a mountain will probably require from eighty to one hundred years in Pennsylvania to attain a diameter of one foot. The same species of tree I have known to reach the same size in forty-five years on better soil. Our common black oak illustrates the same principle in the lifetime of one and the same tree. Thus there are specimens in Centre county which grew with the average rapidity of the species for, say, forty years and then suddenly ceased to grow and began to die at the top because their roots had reached a bed of limestone just beneath the surface of the soil. So, too, I have in mind specimens of white and scarlet oak, which, under favorable conditions, kept pace in growth with sugar and silver maples near which they were planted.

A second growth, sprouting from vigorous stumps, develops much more rapidly than the original growth where the roots were smaller in proportion to the trunk. This explains the peculiar strength and value for certain mechanical purposes of the second-growth white oak in the rich lands of Indiana and Illinois. It is simply an illustration of the statement already made that the larger year's growth made a better lumber than the smaller (in the same species).

As a rule, we may say that a century will be required to mature white pine, hemlock and the hickories. The oaks will require half as much longer time. Chestnut may be regarded as making a fair body of mature wood in seventy-five years.

V. Obstacles to the Growth of Timber.

(a) *Natural Obstacles.*

These have been in part anticipated by the statements already made. Among these poverty of soil may be regarded as first in importance. This, however, is connected with an induced poverty due to removal of an earlier forest growth whereby on the steeper slopes the soil is washed away more rapidly than it is renewed. Indeed, one philosophical observer has stated that if the forests were removed from our Pennsylvania mountains and they allowed, for any considerable time, to remain without trees, that reforestation would be practically impossible. Whether this statement is, or is not, true as a scientific principle, it may at least be

allowed that the difficulties of producing a new forest growth would be infinitely increased. Fortunately we are, to a very great extent, exempt thus far from the fungal and insect foes which have produced such serious havoc in Central Europe. It is, however, within the limits of probability that there may come a time when this immunity will cease. For example, in the Adirondacks certain of the cone-bearing trees have to a limited extent been injured by the fungus which produces the clustered branches known as "witches' brooms;" and in Fulton county of this State, one or more small species of beetles have within the last three years killed considerable bodies of pitch pine by burrowing beneath the bark and destroying the young cambium layer on which the life of the tree depends. It is estimated that in West Virginia these same insects have destroyed $1,000,000 worth of timber in the last four years.* It is interesting to note that an insect antagonistic to these beetles has been found in considerable numbers on the infested trees. To what extent they may succeed in holding the beetle in check remains to be seen. The most promising plan of treatment would seem to be to cut and burn every infested tree. The fact that thus far the insect invasion has been slow and affecting only isolated clumps indicates the possibility of successfully heading it off if dealt with promptly.

The natural tendency in this State is towards a spontaneous reproduction of forests. This shows that the obstacles are neither numerous, nor grave in character.

(b) *Obstacles Due to Human Agencies.*

The chief obstacle here is fire—operating now in one way and now in another—and caused by design, often with malicious intent, or by accident on the part of an individual, or by a passing train.

Fire acts directly and indirectly to prevent the growth of timber.

Thus directly it kills the seeds, saplings, and often mature trees, such as the hemlock and the white pine.

The most destructive fires are those which follow close upon the operations of the lumberman. The débris left by him invokes the flame and furnishes the requisite fuel for it, when once created. One severe conflagration, especially if on a steep hillside, may not only blight the promise of a coming crop of trees, but may lead to the destruction of the soil to such an extent that almost no plant life can flourish. And year by year the little remaining soil is carried away by the descending rain until restoration of forest growth seems almost impossible. Instances of this condi-

* This note from Mr. Charles W. Johnson explains itself:

"There are several species of beetles destructive to the pines of West Virginia. The principal ones are *Dendroctonus frontalis* or 'The Destructive Pine Bark Beetle.' *Tomicus calligraphus*, and *Tomicus cacographus*, the latter is the one we found in Fulton county. The Clerus imported from Europe is the *Clerus formicarius*, 'European Bark Beetle Destroyer.' The one we found in Fulton county is closely allied and is known as *Thanasimus dubius*."

tion occur near the head of Long Run, in Clinton county, and in portions of the Beech Creek region in Centre and Clinton counties.

Fires are frequently created to destroy the young timber and to encourage the growth of grass for summer pasturage for cattle. The writer saw one such instance during the past season where a most valuable body of young white pine was destroyed, and it seemed morally certain that it was by a fire started in the interest of a score of vagrant cattle. Of course the remedy for such a state of affairs might be prompt and sure. Confiscation of such cattle, by due form of law, when found without permission on land of other parties would end once for all this burning. There can be no doubt that a considerable percentage of forest fires is the result of absolute maliciousness. Luzerne county of this State, but a few years ago, furnished numerous examples of what were doubtless to be attributed to this cause. The cure here is by no means so simple as at first appears. The remedy which seems most popular at present, not only in this, but other States, *i. e.*, authorizing supervisors, or other officers, to call out men to suppress forest fires and paying them for their work, has been found by actual trial in several counties of this State to be an inducement to create fires on unseated lands. It is a humiliating admission, but it is clear that those and other regions of our own Commonwealth are not sufficiently law-abiding, or observant of ethical principles, to make this method practicable. The enactment of rigid and severe penal statutes is a matter of doubtful value, unless accompanied by a costly machinery to ferret out and bring offenders to justice. Opening of fire lanes through the timber lands raises the question by whom shall it be done—at individual or at State expense? The same may be said of keeping them open. There can be no doubt that well-kept fire lanes do render suppression of such fires more easy, even if they do not interpose a certain barrier to their spread. It will probably become more and more clear that timber protection and production in this State will be effective and common just in proportion as it is made to the interest of the individual citizen to guard and plant trees. Here we come back to the most general of all principles under a popular government, that laws are strong and effective only when backed by public sentiment, and this may only be surely attained by an appeal to individual interests. This brings me to

VI. Relation of the Commonwealth to Forest Restoration.

The first duty of government is either to perpetuate itself or to lead up to some higher, better form of government. On this hangs not only the safety of vested rights and the safety of capital, but the strongest incentives to individual thrift, industry, economy and rectitude are found in the idea that property acquired may be transmitted under protection of a stable government. There is no crime more unpardonable in the individual than the treason which strikes at the safety of the government. Is the act by which the State endangers its own prosperity and perpetuity

any less heinous? This reduced to its simplest terms is the issue now before the Commonwealth. Already after but two hundred and fifty-six years of civilized occupancy, Pennsylvania is called upon to interfere in order to restore to a productive condition, and to protect against extravagant use, about one-eighth of her area. Failure to act promptly now, and wisely, will entail on the coming generation loss of resource, individual suffering and increase of taxation to meet the demands of pauperism. These propositions seem so clear in the light of present resources and prospective population that it is a waste of words to discuss them.

There are, at least, three thousand square miles in this State to-day whose only possible function is the production of timber. There is, at least, an equal area of land now cleared, impoverished and becoming poorer each year, on which cultivation has been attempted, and proven hopelessly unremunerative, which should be covered again by a forest growth. No other proposition promises anything. Unless these six thousand square miles are kept in a productive condition they will be an absolute loss to the State and a continued menace to much of the productive farming land.

The problem is one of great magnitude. Two and only two lines of public policy are possible. The first one is for the State to assume control of such areas. The second is for the individual to be encouraged to make these areas productive under the stimulus of State direction and State aid. Which shall it be?

Where an area is distinctly isolated, and as yet in an unimproved condition in great part, on general principles it might be wiser for the State to assume direct and absolute control of it, because a far-reaching policy could be inaugurated which would look to the largest results ultimately. The necessity for such action would be more and more apparent if it could be shown that it was directly in the interest of the Commonwealth that the State should be the possessor of the land.

The State of New York undoubtedly is in that position to-day. The wisdom of her acquiring an absolute right to the Adirondack region by just and legal extinguishment of all individual titles, will depend upon no other condition than what use she makes of the land.

The State of Pennsylvania is not so fortunately situated. Her natural timber areas extend clear across from the northern to the southern border and almost bisect her territory. Important railway lines run through her belt of natural timber lands. Large rivers traverse them and thriving farms, villages and towns occupy the choicer parts of these areas, which as a whole may be designated as almost exclusively natural woodlands. Clearly the State could acquire no righteous title, nor could she, even if ownership were possible, administer an estate so broken and disconnected in an economical manner.

The remaining alternative is to recognize the fact that protection and utilization of these regions is of the first importance to the Commonwealth and to make it the interest of the citizen to serve the State. To this

proposition it is thought no one will object. But at present the State and the individual are absolutely at cross purposes so far as the timber lands are concerned. The township demands taxes for a protection which is not accorded; for improvements which it does not make and for profits which the owner does not receive. The facts are at hand to show that in certain portions of the State, timber land, which has yielded the owners nothing for thirty years, has in that period paid more in the way of taxes than the land could be sold for to-day. Is it strange that to save themselves, the owners of such lands should remove the timber and realize what they can, then abandon them rather than pay the taxes? This same timber would be worth much more to the owner if allowed to stand. The township which drives the man to remove this timber, then to abandon the land, loses at once taxes for present use, and resources of future value. It requires no argument to prove that this is a false policy.

We will briefly consider the results of a removal of taxes from timber land.

In the first place it would confer new value on these lands. Owners would, instead of wholly abandoning them, at least retain them. Retaining them, even uncared for, there would something of value grow upon them. Here and there a tree, often a young growth of forest trees; and what was of no value would come now to have a positive value, however small. The owner would have an interest, and what applies to the individual owner would apply to the community, and the man who by accident or by design fired land which was producing something and costing nothing would soon be a marked person. Public sentiment instead of looking almost with indifference on woodland fires would become actively interested in their suppression. Fire laws would have, what they do not now have, support; and the law which hitherto was a dead letter would become a living, real thing. So much gained as timber was becoming scarcer, the next inevitable step would be to increase the quantity of timber produced, to improve its quality and to diminish, so far as possible, the time required to mature it, as well also as to make the maturing forest pay for its own maintenance.

Here we have at once the germ of a forestry system. It would have the further advantage of being a system developed in harmony with our own environment. It is probable that in a quarter of a century we should be further on towards success than if we tried to adopt and adapt a foreign system to the conditions of a popular government.

Not only would the steeper, rocky hillsides respond productively to this new policy, but at once another element would enter the problem. Lands hitherto taxed as farm lands, but which were unremunerative, under cultivation would be planted in trees. And from being costly unproductive lands, become productive lands entailing no cost. The barren hillsides of this generation would have their virgin fertility partly restored and by the time they were required to produce crops for the larger population half a century hence would be in condition to do so. Then, when

the average farms have become reduced in size and a better system of agriculture inaugurated, we might hope they would be prevented, even if cleared, from relapsing into the unproductive condition in which they are found now. Probably by that time timber growing as a legitimate branch of agriculture would be established among us, and they would be found to pay enough to warrant keeping them in timber.

There are, however, two sides to this question. The Constitution of this State reads thus: "*Art. iii, Sec. 7.* The General Assembly shall not pass any local or special law exempting property from taxation."

It furthermore, *Art. ix, Sec. 1*, expressly declares "that all taxes shall be uniform upon the same class of subjects within the territorial limits of the authority levying the tax, and shall be levied and collected under general laws: but the General Assembly may by general laws exempt from taxation public property used for public purposes, actual places of religious worship, places of burial not used or held for private or corporate profit, and institutions of purely public charity.

"*Sec. 2.* All laws exempting property from taxation, other than the property enumerated, shall be void."

It will be seen from this that as timber lands are not in the favored classes their exemption from taxation was clearly forbidden.

The Constitution, however, distinctly recognizes the constitutionality of classification in persons and things to be taxed. *Art. ix, Sec. 1*, already quoted, expressly declares for it in the phrase "all taxes shall be uniform upon the same class of subjects."

It may be an open question whether or not it may be possible to claim exemption from taxes for timber lands on the ground that as they collected water from the State at large, as they aided in retaining the fertility of the soil on land other than that of the forest owner, they were in fact and deed "objects of purely public charity, or lands used for public purposes;" until the owner derived a revenue from them by the removal and sale of wood. It is, however, clearly within the power of the General Assembly to place them in a class by themselves under a specified minimum rate of taxation, because they are under different conditions of production and are wholly different from any other lands, and for the good of the Commonwealth require legislation different in character from any other lands. "Laws enacted in pursuance of such classification and for such purposes are, properly speaking, neither local nor special." It is equally clear that if tax were collected from such lands classified as a separate class it would be under a general law, which specified no individual, but dealt with a whole class of persons, all of whom were similarly conditioned.

Then again, even if tax were removed, or greatly reduced, on timber lands the whole problem would not be solved, because this would deprive many portions of the State, where an excess of timber over cleared land remains, of the funds required for current expenses. This difficulty is a serious one, and unless the deficit be made good, would be an absolutely

prohibitory objection to total or partial exemption of timber lands from taxation.

Let us consider this problem from another point. The water which turns our factory wheels and which is used by our larger towns and cities; whence does it come? As a rule, from forest-covered hillsides in remoter parts of the State. The mills, towns and cities seldom pay anything for it until it reaches their seats. The men who own the land pay the taxes and receive actually less from it than those who pay nothing for it. Put the proposition in its baldest form: The City of Philadelphia pays nothing for an element which is essential to its life and without which it could not endure a day until it reaches the city limits. Another portion of the community is taxed that we may receive our water free. Is this fair? The comparisons between air and water supply are not parallel. No one is taxed for air, we simply ask that these cases be made parallel by taxing no one for production of water. It is not too much then to say that the State at large is the beneficiary of the woodlands. Nor is it too much to ask that legislation be granted by which such counties of the State as endure a hardship by removal of taxes from their timber lands should be relieved by the State to the extent of their financial loss from this cause.

When timber comes to be removed it ceases to be a purely public benefit. It enters the domain of individual or corporate trade and should be taxed accordingly.

It is becoming more and more clear that officials are required whose duty it shall be to direct suppression of fires, and to ferret out offenders. The law should be imperative that every magistrate in the Commonwealth should report through proper channels at each session of Court all he knows of forest fires since previous session. It should be made a specific duty, to any evasion of which a penalty in some form should be attached. The State already allows annually a premium on trees planted thus: For 1200 to the acre during the first ten years ninety per centum of the tax paid on the same ground, providing said premium shall not exceed the sum of forty-five cents per acre. For the second period of ten years the premium is eighty per centum, providing that the premium shall not exceed the sum of forty cents per acre.

For a third and final period of ten years the premium shall be fifty per centum, providing that the premium so paid shall not exceed the sum of twenty-five cents per acre.

During and after the second period of ten years, the land owner may thin out his trees to not less than 600 per acre "so long as no portion of the said land shall be absolutely cleared of the said trees."

Nurserymen or other tree salesmen are not included in the benefits of this act.

Timber land which has been cleared may receive the same premium as above indicated, providing that notice has been given within one year from date of clearing of the owner's intention to maintain said land in

timber; the number of trees per acre required is the same, and, on the other hand, the privilege of thinning is the same as to time and number.

It is quite remarkable that so few of those who might have taken advantage of this law have been aware of its place on the statute book. The Commissioners of Schuylkill county have, however, paid to the Girard estate money due under the provisions of this act. The precedent is therefore established, and others may be expected to avail themselves of the benefits offered.

It will be seen, however, that liberal as these premiums are, they fail at the very period when there begins to be a temptation to cut, and when the average tree is in the state of its greatest productiveness, so far as the growth of wood is concerned. The woodland owner may keep his domain constantly in condition to earn the government premium; but he will produce no thoroughly good-matured wood if he is encouraged to cut it at thirty years of age.

These bounties mark an important advance in public sentiment on the forestry problem; but they fall far short of the full measure of usefulness one might expect from a complete remission of taxes, when such remission is based on an appreciation of the fact that public rather than private interest is most subserved by it.

It is clear that the question of an extensive State Forest Reservation is one which cannot be much longer postponed. That this is demanded not less in the interest of a pure, abundant water supply than it is by the ordinary interests of forestry is no less clear; and it almost follows as a matter of course that such reservation should be located on the watershed which supplies the largest quantity of pure water to the largest population. In this view of the matter, the spot where such reservation should be is plainly indicated by the topography of the State. It should be noted further that this reservation might be made equally available as a public sanitarium. It cannot be too strongly or too often noted that it is a measure of wise statesmanship, to provide an outing ground where those who are physically below par may by a sojourn in the open air of a wholesome region find renewed strength for the duties of life. This is suggested not on any basis of philanthropy or sentiment, but simply because it promises to reduce the number of those who otherwise might become charges on the Commonwealth.

VII. Methods of Forest Restoration.

This division might come more properly in a treatise on practical forestry. Still it may be proper to make certain general statements here on the subject. So far as known, there are at present within the limits of the State but two areas which might with any degree of propriety be designated as illustrating forestry practice. Both of these are managed as a portion of the City Trusts, and are located one in Schuylkill and the other in Centre county.

Forest restoration in this Commonwealth should be mainly confined to two classes of ground—first, that which is fit for nothing else and otherwise would be unproductive, and second, that which is worn out by unproductive agriculture, and which would be more promptly and cheaply restored to virgin fertility by a return to primitive conditions. It is probably a safe estimate, as already indicated, that there are not less than six thousand square miles of territory which belong to one or the other of these classes; or to put the statement in another way, about one-eighth of the area of the State.

It is well to urge, that for the present and the immediate future, public or private forest operations of a restorative character should be confined mainly to such native forest trees as make the most certain and speedy growth. This would not necessarily exclude such trees as the oaks, for under favorable conditions these may be classed as rapid growers when compared with related trees elsewhere.

The most promising of the native trees would be white pine, chestnut, locust, black walnut; and on rich soil, shellbark, hickory and white oak. Hemlock culture will eventually become a necessity to the Commonwealth, but owing to its slow growth and its uncertain success had better not at present be urged. White oak is a tree of wide growth and therefore not so immediately in danger of becoming below our actual wants in quantity. Chestnut grows freely over a wide range of conditions; in other words, its natural tendency is to take care of itself. These facts make white pine the one tree whose immediate culture is most promising and most needed. How shall its restoration be most successfully undertaken? There are two methods, which we may properly designate as the nursery method and the method in final position. The former is probably not soon likely to become popular. Hence the latter method is the one most certain to lead to successful results in this country. The young trees of this species are sensitive, as most cone-bearing trees are, to excess of sunlight. It should be started under the shadow of an existing open forest cover which is soon to be removed. To meet this condition, white pine seed should be sown, when possible on a northern exposure, in poor, or at least, in rather poor soil. The mature cones may be gathered in the autumn, kept in a cool dry place until spring, when many of the winged seeds will be found to have escaped from the cones. The remainder may be obtained by shaking or breaking the cones. Early in the spring, the sooner after the frost comes out of the ground the better, the leaves of the open woods should be lightly raked from the soil, in spots, so as to give the seeds a chance to come in contact with the soil, or at least with the damp leaves. Then cover the seeds lightly with a rake. This is rendered necessary by the fact that though the seeds of the white pine are well enough adapted to dispersion, they are not so well suited to self-planting, and many must fail of growth because they do not come in contact with a suitable substratum. When the young pines are three or four

years old the sheltering forest will have done its work and may be removed at any time.

It should be remembered that the cone-bearing trees are social in character and hence do better in dense groves. In fact, one may also say dense planting is an essential condition upon which rests the production of the best pine timber. It is probable enough that starting white pine in nurseries will some day come to be here, as elsewhere, the more common method, but it involves too much labor and care to recommend it at this stage of the Forestry Idea in the United States, or certainly, at least, in Pennsylvania.

Black walnut will always have a special value, and to make the idea more clear, it should be added that this value will depend on the character of the individual log. There are in this State thousands of acres of fertile river bottoms where agriculture has been practically abandoned because of the frequently recurring freshets, on which the black walnut would not only grow rapidly, but where it might be depended upon to produce a good quality of lumber. This tree does not, at first, grow rapidly on a soil of stiff limestone clay.

There is no surer way of starting the black walnut than to allow the fruit to remain out over winter under a slight cover of leaves. When spring comes it will probably be found that the frost has opened the fruit so that a prompt start that spring may be expected. As the black walnut does not bear transplanting well, it is better that the nuts should be planted where they are to remain.

All that has been said of the method of starting the black walnut applies to the shellbark and hickory as well.

The white oak is worthy of a moment's consideration. It grows with great certainty from good acorns, and may be planted in drills as soon as collected. If one thinks it really worth while to have his trees in the best condition for a vigorous start when finally transplanted, it is a good policy to lift and replant the young oaks at least twice before they are placed in permanent position. Good soil should be insisted upon as a cardinal point in white oak planting. If poor soil is to be occupied by oaks let the planting be of rock oak, providing the soil is well drained. All that has been said as to starting the white oak applies as well to starting the rock oak. The same may be said of the chestnut.

Our common locust tree, it is not generally remembered, is a native of the mountain sides of this State. This fact should suggest the extreme value it possesses in reclothing those steep, poor regions with a timber whose value will always be appreciated. It has the further fact in its favor, once fairly started, it resists better than almost any other species of our trees, the periodical scorchings it receives from the spring and autumn fires.

Further consideration of this topic from the practical standpoint would be out of place here.

Association: The Dominating Need of Man and the Keynote of Social Science.

By Henry Carey Baird.

(*Read before the American Philosophical Society, March 16, 1894.*)

Never before to-day, in the history of the human race, has there been so earnest or so widely extended an examination of economic problems. At this very hour the philosophers of the orthodox political economy and their philosophy are on trial before Christendom; and the issue is not: Is the philosophy true or is it false? But rather: Is it or is it not so false and pernicious that when applied to human society that society is wholly unable to stand the strain, and is constantly, as a result, in danger of wreck?

Social Science is fast emerging from that place wherein it has long been the plaything of school-men, who acknowledge themselves as being the teachers of "a science based on assumptions." Soon these teachers will be classed as mere metaphysicians, whose disquisitions can lead to no beneficent practical end, and their learned treatises will finally be consigned to that great lumber-room of the centuries which holds the larger part of the literature of the world, the forgotten, because useless books. Empires, kingdoms, republics, even society itself trembles in the balance, and these philosophers of "assumptions" have held the leading role in the terrible drama which places all of these human institutions in peril.

Therefore, does it seem fitting that so venerable and so renowned an institution as the American Philosophical Society should give some heed to the consideration of these vital problems. Hence do I ask your attention to

Association: The Dominating Need of Man and the Keynote of Social Science.

Of Social Science.

In science the most important preliminary work is that of definitions, in order that the exact meanings of words may be distinctly understood, and when so understood, that those words shall always be used with the same significance. Social Science treats of man in his efforts for the maintenance and improvement of his condition, and as defined by the Master, Carey, is "The science of the laws which govern man in his efforts to secure for himself the highest individuality and the greatest power of association with his fellow-men." This definition is not only broad and comprehensive, but it points unmistakably to the true direction in which we must look for the investigation and solution of each and every principle in social science It uncovers and lays bare the very tap-root of the science itself.

The Fundamental Principle.

From this definition it is but one step to the fundamental principle and this principle as enunciated, also by the Master, is as follows:

"Man, the molecule of society, is the subject of social science. In common with all other animals he requires to eat, drink and sleep, but his greatest need is that of *association* with his fellow-men. Born the weakest and most dependent of animals, he requires the largest care in infancy, and must be clothed by others, whereas to birds and beasts clothing is supplied by nature. Capable of acquiring the highest degree of knowledge, he appears in the world destitute even of that instinct which teaches the bee and the spider, the bird and the beaver, to construct their habitations, and to supply themselves with food. Dependent upon the experience of himself and others for all his knowledge, he requires language to enable him either to record the results of his own observations, or to profit by those of others; and of language there can be none without association. Created in the image of his Maker, he should participate in His intelligence; but it is only by means of ideas that he can avail himself of the faculties with which he has been endowed, and without language there can be no ideas—no power of thought. Without language, therefore, he must remain in ignorance of the existence of powers granted to him in lieu of the strength of the ox and the horse, the speed of the hare, and the sagacity of the elephant, and must remain below the level of the brute creation. To have language there must be association and combination of men with their fellow-men, and it is on this condition only that man can be man; on this alone that we can conceive of the being to which we attach the idea of man."*

All Social Science must Start from the Law of Association.

All true social science must of necessity start from this point. It can start from none other; and any system which attempts to ignore this fundamental principle, as such, is false in its inception, and must of necessity be false throughout. There is no escape from this dilemma. The all-controlling condition which governs man in this world is that which obliges him to associate and combine with his fellow-men. Literally from the cradle to the grave, it controls his destiny and is at the bottom of all of the motives which, throughout his career, impel him to action. He is thus insufficient unto himself, and the higher his civilization the greater become his wants, and, therefore, the greater his dependence on his fellow-men and the more rigid and unyielding over his daily, his hourly life, the domination of the law. All social science is concerned about it; and without it there would be no social science, no political economy, no wealth, no poverty, no money, no banks, no interest, no credit, no landlords, no tenants, no states, no cities, no towns, no villages, no governments, no taxes, no emperors, kings or presidents, no armies, no navies, no generals, no admirals, no steamships, no railroads, no

* Carey, *Principles of Social Science*, Vol. I, p. 41.

mails, no post-office, no corporations, no shops, no trade, no commerce, no colleges, no schools, no poets, no historians, no history, no literature, no science, no philosophy, no language, no professors, no doctors, no lawyers, no laws, no society; but each and every man and woman would be a law and a power unto himself or herself; and so would every child, from the moment of its birth to the hour of its death. Indeed, the entire life of each and every human being would be different from what it now is, and no one would have any occupation whatever, except that of looking after his or her necessities. Thus, would each and every one of these human vegetables live, grow, and flourish like any other vegetable independent of his fellow-vegetables. In fact, the human animal of many of the economic philosophers partakes more of the nature of the vegetable than of that of the human being known as *man*, because this philosopher has ignored and dropped out of his system the very quality which most characterizes and controls man and which most separates him from the lower forms of life, both animal and vegetable.

Wealth and Poverty, What are They?

What then is it that men struggle for, and worry about, live, wear out, and die to obtain, and retain under the name of individual wealth? It is simply the power to associate with, to command the services, the commodities and the ideas of the largest body of men. What then is individual poverty? The absence of the power readily to command these services, commodities and ideas. Thus, whether he be prince, millionaire, or pauper, man perishes of cold, of heat, of hunger, of thirst, of want, unless he can bring himself into association with his fellow-men. To sum up, the life of man is but a series, a net-work, a complication of acts of association, to cease the performance of which acts is, of necessity, to cease to live.

Diversity.

The question now arises, How is this power of association to be developed? Primarily, by means of a diversity in the capabilities, employments, productions, and wants among the people constituting society; to the end that there shall there exist the greatest number and the most powerful societary positives and negatives attainable or conceivable. To accomplish this the consumer must be brought to the side of the producer, the plough, the loom, and the anvil, the farm, the factory, and the workshop existing and growing up alongside of and in harmonious relations each to the others, giving and receiving, blessing and being blessed. Thus, and thus only, can labor power, the most perishable of all commodities, be utilized on the instant of its production, and crystallized into work, the basis of all wealth, individual and national. No foreign commodity is therefore cheap or desirable to a people, no matter how low its price, while the labor at home is going to waste which might be employed in its production. Hence the necessity for every people to

build up thoroughly diversified industries at any cost and any sacrifice of present apparent cheapness. On this impregnable rock does the protectionist plant himself and defy the enemy, be he philosopher or be he boor.

Money the Instrument of Association.

By means of the brilliant, all-pervading sunlight, which the recognition of the true place held by the law of association at the very foundation of society sheds upon the societary problem, the function of money assumes a new position, and the accumulated rubbish of centuries which has covered up and obscured it is completely brushed aside. In no other direction than that of the appreciation of the life-giving function of money, that of ministering to man's need for association and combination with his fellow-men, can we so confidently look for the emancipation of man himself.

Starting from the basic law of association, the Master has happily termed money *the instrument of association*, and it thus ceases to be the dead, inert thing which it has so long been supposed by the Greshams, the Smiths, the Humes, the Ricardos, the Huskissons, the Peels, the Overstones, the Mills, the assumption economists generally, and the army of so-called "statesmen," to be. Money, as the instrument of association, becomes a vitalizer, a producer, a utilizer of human labor power; a large volume of money, thus, under certain circumstances, being quite consistent with cheap production, as will be made more apparent in the sequel. Acknowledgment of the law of association as a basis, furnishes the only rational means of accounting for a host of problems touching money, which are of everyday occurrence and observation, although in direct antagonism to the theories of the philosophers.

The daily life of a civilized people, involving such countless millions of acts of association or commerce, such myriads of compositions, decompositions and recompositions of services, commodities and ideas, a medium having the qualities of universal acceptability and of almost unlimited divisibility and aggregation, is absolutely necessary to that life. In the early stages of society, and in isolated communities, there is but little societary life, and there man is dependent upon but comparatively few of his fellow-men, while in a city like London, Paris, New York, Philadelphia or Chicago there are many thousands of individuals, each of whom daily calls for the services of millions of men. Indeed, the purchaser of a copy of the *Herald*, *Tribune*, *Press* or *Ledger*, in making that purchase calls for the services of the millions of men who have, in any way, contributed to the production of one of these papers, even so remotely as by making the material of which the railroads or telegraphs have been constructed, by means of which the raw materials of the newspaper and the news have been conveyed all the way through from the miners of the coal, and the smelters of the metals, in the machinery used in its production, to the makers of the paper and the type, to the compositors, press-

men, editors, distributors, etc., etc. From the standpoint, and through the luminous ether, of the law of association or commerce, as at once the centre, the circumference, the foundation, the all-pervading spirit of social philosophy, the study of the millions on millions of compositions, decompositions and recompositions of services, commodities and ideas involved in a pile of a single issue of a great daily newspaper, is indeed the study of and the royal road to the mastery of the best part of social philosophy itself.

Labor Power.

It cannot be too fully, too distinctly, too forcibly impressed upon the mind that it is the utilization of labor power which ameliorates the condition of mankind, creates wealth, and causes the wide and just diffusion of that wealth. Such utilization is, indeed, the one and only basis of individual well-being, and of national power and civilization. It is, in a word, the single road which leads to the emancipation of man.

The life of a civilized people thus involving countless millions of acts of association or commerce, the absolute condition on which these acts can be performed, and the labor power involved in these acts be utilized, is an abundance of the medium, *money*, with its quality of universal acceptability, and which thus acts as a "saving-fund for labor" and by facilitating "association and combination gives utility to billions of millions of minutes, that would be wasted did not a demand exist for them at the moment the power to labor had been produced."

Thus was it the law of association which, dominating the life of man, caused, in the far-off ages, the institution of money, it being an absolute necessity growing out of man's nature. It had to be; it must now be; it will ever be while man inhabits the earth; and it can find no philosophical explanation, except through the recognition of the supreme and all-controlling law of association between man and his fellow-men. On this ground the greenbacker and the silver man can take their stand and defy all adversaries. On the broad foundation rock of association, the protectionist and the greenbacker and the silver man can alone come into harmonious relations and associative coöperation.

Association and the Power Arising from its Control.

Scattered, isolated men are always feeble and powerless for great undertakings, because of the absence of ability to exchange services, commodities and ideas, to associate, with their fellow-men. On the other hand, the most powerful men in the world are those who centre round the exchanges or bourses of New York, London, Paris, Berlin, Amsterdam and Vienna. The great power of these men arises from the fact that while having great ability to associate among their several selves, by control of the instrument of association, money, and its greater representative, credit, they control the power of association among hundreds of millions of men, women and children throughout the world. It is even in the power of these dictators largely to arrest association among mankind, and they do it.

How Man Obtains Control over Nature.

With the high development of the power of association in advancing communities, the forces of nature are more and more harnessed into the uses of man, taking the place of human bone and muscle, and even of the bone and muscle of animals, three tons of coal representing the labor of a man for his entire life.

Thus, while the animal force expended in the conversion of raw products into finished commodities decreases in proportion to the total volume of conversion, the money cost of that conversion also decreases. At the same time raw products, including land and labor which before had no value, being now utilized, acquire value. So, by a beautiful and compensating law, land, labor and other raw products rise and finished commodities fall. The laborer thus, by virtue of the Master's law of distribution, obtains a larger proportion of a larger yield, and acquires growing freedom and independence. With these advances, man is steadily obtaining the power to call to his aid better and more efficient tools, among which none is more important than land. At first weak, with but little power of association, he is able only to cultivate the light, sandy soils and those at the heads of rivers or the dry and slightly wooded ones on the sides of the hills. Only as he is able to command the services of his fellow-men, is it that he obtains power to cope with the wet, rich and heavily timbered lands of the valleys, reeking with malaria and requiring drainage.

The Movements of Money.

Having considered the effects of the instrument of association on association, let us now see how association affects the movements of the instrument itself.

Money *leaves* those places where there is no diversification of employments. and where money is scarce and interest high ; where land, labor and other raw materials are cheap, and where finished commodities are dear. It *goes* to those places where industries are diversified, and where money is plenty, where bank-credit is large in volume, and interest is low, where land, labor and other raw materials, being utilized, are high, and where finished commodities, through the intervention of brains, chemistry, electricity, steam and machinery, are, as well as interest, low. In a word, money travels *from* those places in which the power of association is not developed *to* those in which it is in the highest degree developed. Thus with the growth of the power of association, wealth, freedom, contentment, harmony and civilization are established, society assuming an ever-broadening base, with a stability which finally eliminates discontent and lawlessness.

The Great and Supreme Law of Association.

Hold up the law of association among men, and view it from any of its countless sides, and the more closely it is studied the more it shows itself

to be, to the world of humanity, what the law of gravitation is to the world or universe of matter. It is the philosopher's stone which transmutes, clears up the temporal mystery of man. This law dogs the outcast and the beggar, whose conditions preclude the possibility of active association; it places the offensive weapon in the hands of the modern boycotter; it says to the man who is tempted to go wrong, Go not, for society will cast you out; it induces the laborer to toil, it spurs the mechanic and the artisan to become masters of their respective trades; it causes the student to burn the midnight oil, and the doctor, the lawyer, the professor to spend years in acquiring and imparting knowledge. The business man who struggles night and day to avoid bankruptcy does so that he may retain that financial credit which enables him to swing a power of association far in excess of that which his capital would give. This law has its most beautiful manifestation in the family, with its tender, loving and self-sacrificing ties of father, mother, and children.

Men build railroads, steamships, steamboats, and hotels, and other men work them because of this law of association; the banker organizes his bank that he may control association and profit by it; governments impose taxes that they may call civilians, soldiers and sailors into association with themselves. An army is an armed association under officers who hurl it, regardless of life or death, against other armies, in order that another association called the state, may live and flourish, and that its citizens or subjects may associate, exchange services, commodities and ideas among their several selves. The post-office, with its machinery for the transmission of letters and printed matter and its postage stamps and money orders and the express in all its details, including C. O. D., are all outgrowths of the supreme law of association.

Conclusion.

Social Science concerning itself with the relations of man to his fellowmen and to the earth which he inhabits, and Association being the Dominating Need of Man in these relations, it follows that Association must be the Keynote of Social Science. Therefore the touchstone for every economic problem is its relation to Association. There is and can be no other test for it; and if it cannot pass this ordeal it must be rejected as false and pernicious.

When once the believers in the necessity for the fullest diversification of our industries, and those others who believe in a volume of money, whether of gold, silver or paper, or of all of them equal to the needs of trade and commerce, place themselves firmly on the basis of the law of association for their justification they will instantly and for all time direct the industrial and financial policy of this people.

And now, once more, we come back to the words of the Master:

"*Man, the molecule of society, is the subject of social science. In common with all other animals he requires to eat, drink and sleep, but his greatest need is that of* ASSOCIATION *with his fellow-men.*"

Stated Meeting, January 19, 1894.

President, Mr. FRALEY, in the Chair.

Correspondence was submitted as follows:

Invitation from the West Virginia Historical and Antiquarian Society, Charleston, W. Va., to attend the Fourth Annual Meeting, Tuesday, January 16, 1894.

Letters of envoy were received from the Australasian Association for the Advancement of Science, Hobart; Académie R. des Sciences, Stockholm, Sweden; Société R. de Geographie d'Anvers, Belgique; K. Leopoldinisch-Carolinische Deutsche Akademie der Naturforscher, Halle a.S., Prussia; K. Sächsische Gesellschaft der Wissenschaften, Leipzig; Faculté des Sciences, Marseille, France; Ecole Polytechnique, Musée Guimet, Paris, France; Geological Survey of New Jersey, Trenton; Mr. Henry Carey Baird, Philadelphia; Société Scientifique du Chile, Santiago.

Letters of acknowledgment were received from the Royal Society of N. S. W. (140); Linnean Society of N. S. W., Sydney (139, 140); Royal Geographical Society (Queensland Branch), Brisbane (140); Royal Society of Victoria, Melbourne (140); Free Public Library, Wellington, N. Z. (134, 136); Société Royale de Geographie d'Anvers, Belgique (131, 132, 140, 141); Prof. Peter R. von Tunner, Leoben, Austria (140, 141); Deutsche Geologische Gesellschaft, Berlin, Prussia (136, 141, and Trans, xvii, 3, xviii, 1); Verein für Erdkunde, Dresden, Saxony (141); Physikalisch-Medicinische Gesellschaft, Erlangen, Germany (141); K. Leopoldinisch-Carolinische Deutsche Akademie der Naturforscher, Halle a.S., Prussia (136–141, and Trans., xvii, xviii, 1); Deutsche Seewarte, Hamburg, Germany (136, 141); Prof. L. Rütimeyer, Basel, Switzerland (141); Schweiz. Naturforschende Gesellschaft, Bern, Switzerland (141); Société Vaudoise des Sciences Naturelles, Lausanne, Switzerland (141); R. Accademia di Scienze Littere ed Arti, Modena, Italy (140, 141); Società Africana d'Italia, Naples (141); Accademia di Scienze Littere ed Arti,

Padua, Italy (140, 141); Prof. G. Sergi, Rome, Italy (141); Geological Society, London, Eng. (140); Botanical Society of Canada, Halifax, N. S. (141); Vermont Historical Society, Montpelier (139); Prof. W. T. Hewett, Ithaca, N. Y. (140); Newberry Library, Chicago, Ill. (140, 141); Instituto Fisico-geografico Nacional, San José de Costa Rica, C. A. (139, 140).

Accessions to the Library were reported from the Académie R. des Sciences, Stockholm, Sweden; Académie R. des Sciences, Bruxelles, Belgique; Nederlandsche Maatschappij Nijverheid, Amsterdam; Kolonial Museum, Haarlem, Noord Holland; Académie des Sciences, Cracow, Austria; Naturforschende Gesellschaft des Osterlandes, Altenberg; Oberlausitzer Gesellschaft der Wissenschaften, Görlitz; Biblioteca N. C., Firenze, Italia; R. Accademia dei Lincei, Rome, Italy; Académie N. des Sciences, etc., Bordeaux, France; Société Historique, etc., du Cher, Bourges, France; Société de Borda, Dax, France; Union Geographique du Nord de la France, Donai; Société de Géographie, Lille, France; Faculté des Sciences, Marseille, France; Redaktion *Cosmos*, Société de Geographie, Musée Guimet, Société de l'Enseignement, École Polytechnique, Société d'Anthropologie, Redaction de *La Mélusine*, Société des Antiquaires de France, Directeur of the *Revue des Revues*, Marquis de Nadaillac, Paris, France; Société de Géographie, Toulouse, France; R. Academia de la Historia, Madrid, Spain; Naturforschende Gesellschaft, Basle, Switzerland; Philosophical and Philological Societies, Cambridge, Eng.; Editor of the *Geological Magazine*, Royal Geographical Society, Meterological Council, Royal Microscopical Society, London, Eng.; Geological Society, Manchester, Eng.; Prof. F. Max Müller, Oxford, Eng.; Philosophical Society, Glasgow, Scotland; Dr. Samuel A. Green, Boston, Mass.; Mr. William John Potts, Camden, N. J.; Franklin Institute, Engineers' Club, Drs. George Friebis, Walter M. James, Charles A. Oliver, Messrs. Henry Carey Baird, William S. Baker, Henry Phillips, Jr., Philadelphia; Johns Hopkins University, Baltimore, Md.; Bureau of the Mint, National Academy of Sciences, Hydrographic Office,

Washington, D. C.; Mr. William Harden, Savannah, Ga.; Mr. George W. Baily, Cedar Rapids, Ia.; Colorado Scientific Society, Denver; Agricultural Experiment Stations, Concord, N. H.; Amherst, Mass.; Ithaca, N. Y.; College Park, Md.; Agricultural College, Miss.; Manhattan, Kans.

A photograph of Prof. John Tyndall, London, Eng., was presented by Mr. F. Gutekunst, Philadelphia.

The President reported that in accordance with the resolution of the Society he had appointed Dr. Daniel G. Brinton to prepare the obituary notice of the late George de Benneville Keim.

The death of Oswald Seidensticker (born, Göttingen, 1824; died, Philadelphia, January 10, 1894), was announced and the President was authorized to appoint a suitable person to prepare the usual obituary notice.

The election for Librarian was taken up and Mr. Henry Phillips, Jr., was unanimously reëlected Librarian for the ensuing year.

The President was authorized to appoint the Standing Committees, which he subsequently did, as follows:

Finance.—Philip C. Garrett, Charles S. Wurts, William P. Tatham.

Hall.—J. Sergeant Price, William A. Ingham, Charles A. Oliver.

Publication.—Daniel G. Brinton, George H. Horn, Samuel Wagner, Patterson DuBois, Horace Jayne.

Library.—Edwin J. Houston, Jesse Y. Burk, William H. Greene, William S. Baker, Albert H. Smyth.

Michaux Legacy.—Thomas Meehan, William M. Tilghman, J. Sergeant Price, Angelo Heilprin, William Powell Wilson.

Henry M. Phillips Prize Essay Fund.—Richard Vaux, Henry Phillips, Jr., William V. McKean, C. Stuart Patterson, Joseph C. Fraley, and the President and Treasurer of the Society, *ex-officio*.

The Secretaries presented for the Transactions a bacteriological study of the water supply of Philadelphia, by Dr. Wright. On motion, the same was referred to a Committee

of three members to be appointed by the President, to examine and report upon.

Mr. Lyman read a paper on the "Age of the Newark Brownstone."

Pending nominations Nos. 1268, 1269, 1270, 1271, 1272, 1273, 1274, and new nomination No. 1275 were read.

And the Society was adjourned by the President.

Stated Meeting, February 2, 1894.

President, Mr. FRALEY, in the Chair.

Correspondence was submitted as follows:

A circular inviting subscriptions towards a memorial bust of Prof. Ernst Hæckel, to be placed at Jena, on February 17, 1893.

A circular from the Council of the Scientific Alliance of New York, inviting contributions to the John Strong Newberry Fund for the Endowment of Original Scientific Research.

Photographs for the Society's Album were received of Prof. Oswald Seidensticker and Prof. J. P. Lesley, Philadelphia; Prof. Justin Winsor, Cambridge, Mass.

The deaths of the following members were announced:

Rev. John Leyburn (Baltimore, Md.), died July 13, 1893, æt. 78.

Prof. William P. Trowbridge (New York), 1893.

Accessions to the Library were reported from the Comité de Conservation des Monuments de l'Art Arabe, Cairo, Egypt; Royal Society of Victoria, Melbourne; Linnean Society of New South Wales, Sydney; Société R. des Antiquaires du Nord, K. Norske Oldskrift Selskab, K. D. Geografiske Selskab, Copenhagen, Denmark; Director of the R. N. Museum of Antiquities, Leiden, Holland; K. K. Geologische

Reichsanstalt, Vienna, Austria; Botanische Verein der Provinz Brandenburg, Berlin, Prussia; Sächsische Meteorologische Institut, Chemnitz; Gartenbauverein, Darmstadt, Germany; Naturwissenschaftliche Verein des Reg. Bez. Frankfurt a. O., Prussia; Prof. E. Renevier, Lausanne, Switzerland; R. Accademia, Modena, Italy; Société de Geographie, Toulouse, France; R. Academia de Ciencias y Artes, Barcelona, Spain; R. Irish Academy, Dublin; Sir J. William Dawson, Montreal, Canada; American Folk Lore Society, Dr. Samuel A. Green, Boston, Mass.; R. I. Historical Society, Dr. H. T. Cresson, Providence, R. I.; Agricultural Experiment Station, New Haven, Conn.; Amer. Museum of Natural History, Amer. Geographical Society, Academy of Medicine, New York, N.Y.; N. J. Historical Society, Newark; Amer. Pharmaceutical Association, Indian Rights Association, Messrs. William S. Baker, H. C. Mercer, W. L. Sayre, Philadelphia; U. S. Geological Survey, Mr. Lester F. Ward, Washington, D. C.

The President reported that he had appointed Dr. H. V. Hilprecht to prepare the obituary notice of the late Dr. Seidensticker.

The President reported the appointment of Dr. Ryder, Dr. Barker and Mr. Bache as a Committee to examine and report on the paper by Dr. Wright, presented at the last meeting of the Society.

The Committee on Dr. Wright's Paper on the "Water Supply of Philadelphia" reported the same to be worthy of publication. On motion, the Committee was discharged and the paper referred to the Publication Committee.

Dr. Cope presented a paper on "The Structure of the Skull of the Plesiosaurian Reptilia, and on Two New Species of this Order from the Upper Cretaceous."

Dr. Cope also presented a paper by Prof. A. T. Chamberlin on "Botanical Names in the Language of the Kootenay Indians of Southeastern British Columbia."

Pending nominations Nos. 1268, 1269, 1270, 1271, 1273, 1274, 1275 were read.

Nomination No. 1272 was withdrawn by its proposer.

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On motion of Mr. Smyth, the Society appointed Messrs. Daniel G. Brinton and Henry Phillips, Jr., delegates to the meeting of the Congres International des Américanistes, to be held at Stockholm in September, 1894, providing that the same shall not entail any expense upon the Society.

The question of permitting persons connected with the public press to be present at the regular meetings of the Society, for the purpose of reporting the same for publication, was brought up by the Secretaries, and after considerable discussion the following resolution, offered by Dr. Daniel G. Brinton, was unanimously adopted:

That the Society disapprove of the presence of professional reporters, in their business capacity, at the regular meetings of the Society.

And the Society was adjourned by the President.

Stated Meeting, February 16, 1894.

Mr. INGHAM in the Chair.

Letters of envoy were received from the Geologische Reichsanstalt, Vienna, Austria; Naturforschende Gesellschaft des Osterlandes, Altenburg, Germany; Verein für Schlesische Insektenkunde, Breslau, Germany; Naturwissenschaftliche Verein für Schleswig-Holstein, Kiel, Prussia; Royal Geological Society of Cornwall, Eng.; Royal Statistical Society, London, Eng.; Royal Irish Academy, Dublin, Ireland.

Letters of acknowledgment were received from the Institut Egyptien, Cairo (141); K. K. Geologische Reichsanstalt, K. K. Naturhistorische Hofmuseum, Vienna, Austria (141); K. P. Akademie der Wissenschaften (140); Botanische Verein d. Provinz Brandenburg (137, 138), Berlin, Prussia; Verein für Schlesische Insektenkunde, Breslau, Germany (139); Prof. H. von Helmholtz, Charlottenburg, Germany (138–141); Gartenbauverein, Darmstadt, Germany (139); K. Sächsische Alter-

thumsverein, Dresden (141); Naturwissenschaftliche Verein des Reg. Bez. Frankfort a.O. (141); Naturwissenschaftliche Verein für Schleswig-Holstein, Kiel, Prussia (135–139); Institut Lombardo di Scienze e Lettere, Milan, Italy; Académie R. des Sciences, Lettres, etc., Modena, Italy (130–135, and Transactions, xvi, 3); Société des Sciences Naturelles et Archeologique de la Creuse, Guéret, France (141); École Polytechnique, Dr. Edward Pepper, Paris, France (141); R. Academia de Ciencias y Artes, Barcelona, Spain (139); Public Library, Boston, Mass. (140); Prof. F. A. Genth, Jr., Lansdowne, Pa. (141); Dr. William H. Furness, Philadelphia (140, 141); Bureau of Ethnology, Washington, D. C. (96–135, 137, 138, 140, and Catalogue, Pts. i–iv); Wisconsin Academy of Sciences, Arts and Letters, Madison (119–141, and Catalogue, Pts. i–iv).

Letters of acknowledgment (142) were received from Dr. Charles B. Dudley, Altoona, Pa.; Dr. Robert H. Alison, Ardmore, Pa.; Prof. James E. Rhoads, Bryn Mawr, Pa.; Mr. Matthew H. Messchert, Douglassville, Pa.; Hon. Eckley B. Coxe, Drifton, Pa.; Prof. J. W. Moore, Rev. Thomas C. Porter, Easton, Pa.; State Library of Pennsylvania, Mr. Andrew S. McCreath, Harrisburg, Pa.; Mr. John Fulton, Johnstown, Pa.; Linnean Society, Lancaster, Pa.; Prof. F. A. Genth, Jr., Lansdowne, Pa.; Academy of Natural Sciences, Historical Society, Mercantile Library, College of Pharmacy, College of Physicians, Philadelphia Library, University of Pennsylvania, Editors of the *Medical News*, Wagner Free Institute, Gen'l Isaac J. Wistar, Hon. James T. Mitchell, Profs. John Ashhurst, J. Solis Cohen, E. D. Cope, Henry D. Gregory, L. M. Haupt, H. V. Hilprecht, Edwin J. Houston, E. Otis Kendall, J. P. Lesley, James MacAlister, Theophilus Parvin, Samuel P. Sadtler, Benjamin Sharp, Albert H. Smyth, Drs. D. G. Brinton, W. C. Cattell, William H. Furness, William H. Goodell, Francis W. Lewis, Morris Longstreth, John Marshall, Charles A. Oliver, W. S. W. Ruschenberger, Charles Schäffer, H. Clay Trumbull, William H. Wahl, Charles Stewart Wurts, Messrs. R. Meade Bache, Henry Carey Baird, Charles Bullock, S. Cast-

ner, Jr., Patterson Du Bois, William W. Jefferis, Henry Phillips, Jr., Franklin Platt, Theodore D. Rand, J. G. Rosengarten, L. A. Scott, Coleman Sellers, Joseph Wharton, Joseph M. Wilson, Philadelphia; Mr. Heber S. Thompson, Pottsville, Pa.; Rev. F. A. Mühlenberg, Reading, Pa.; Dr. William Hyde Appleton, Swarthmore, Pa.; Dr. John Curwen, Warren, Pa.; Philosophical Society, Mr. Philip P. Sharples, Prof. J. T. Rothrock, West Chester, Pa.

Accessions to the Library were reported from the Royal Geographical Society, St. Petersburg, Russia; Ministerie van Binnenlandsche Sachen, The Hague; Verein für Beförderung des Gartenbaues, Berlin, Prussia; Verein für Schlesische Insektenkunde, Breslau, Prussia; Naturwissenschaftliche Verein, Kiel, Prussia; Royal Geological Society, Cornwall, Eng.; Royal Statistical Society, Geological Society, London, Eng.; Mr. A. McF. Davis, Cambridge, Mass.; Essex Institute, Salem, Mass.; University of the State of New York, Albany; Prof. Edward North, New York; Philadelphia Hospital, Forestry Association, Prof. George F. Barker, Philadelphia; Enoch Pratt Free Library, Baltimore, Md.; Bureau of Education, Anthropological Society, U. S. Naval Observatory, War Department, U. S. Coast and Geodetic Survey, Treasury Department, U. S. Fish Commission, Smithsonian Institution, U. S. National Museum, Dr. Albert S. Gatschet, Washington, D. C.; Artillery School, Fortress Monroe, Va.; Editor of the *Journal of Comparative Neurology*, Granville, Ohio; Michigan Board of Agriculture, Lansing; University of California, Berkeley; State Historical Society, Iowa City, Ia.; State Historical Society, Madison, Wis.; Kansas University, Lawrence; Asociacion de Ingenieros y Arquitectos, Observatoire Météorologique Central, Observatorio Astronómico N. de Tacubaya, Mexico, Mexico; Muséu Nacional, Rio de Janeiro, Brazil; Agricultural Experiment Stations, Kingston, R. I.; Lexington, Ky.; Lansing, Mich.; Berkeley, Cal.; St. Anthony Park, Minn.

Photographs for the Society's album were received from

Marquis de Nadaillac, Paris, France; Mrs. Helen Abbott Michael, Philadelphia.

The following deaths were reported:

George W. Childs, Philadelphia, February 3, 1894, æt. 64.

Rev. Henry S. Osborn, Oxford, Ohio, February, 1894.

The President was requested to prepare a note to be entered upon the minutes of the Society in reference to the death of Mr. Childs.

The Publication Committee reported that it would not be practicable to publish Dr. Wright's paper on the Water Supply. On motion the paper was ordered to be returned to its author.

The Secretaries reported that the paper by Prof. A. F. Chamberlin, entitled "The Botanical Names in the Language of the Kootenay Indians," was not desirable for publication.

This being the evening for voting for candidates for membership, pending nominations Nos. 1268, 1269, 1270, 1271, 1275 were read, spoken to and balloted for.

Action on pending nominations Nos. 1273 and 1274 was deferred until May 18, 1894.

The proceedings of the Board of Officers and Council were submitted.

Dr. Cope made a communication on "Energy in Evolution."

Dr. Brinton read a letter from Mr. J. C. Pilling in reference to a desired exchange, and the matter was referred to the Secretaries with power to act.

At the end of the evening, the votes cast having been counted, the tellers reported the state of the poll to the presiding member, who declared that the following had been duly elected members of the Society:

No. 2227. Colonel Henry A. DuPont, Wilmington, Del.

No. 2228. Sir Henry Bessemer, London.

No. 2229. Dr. Hermann Snellen, Utrecht.

No. 2230. Julius F. Sachse, Philadelphia.

And the Society was adjourned by the presiding member.

Stated Meeting, March 2, 1894.

President, Mr. FRALEY, in the Chair.

Mr. Julius F. Sachse, a newly elected member, was presented to the Chair and took his seat.

Correspondence was submitted as follows:

A letter accepting membership was received from Col. Henry A. DuPont, Wilmington, Del.

A circular from the National Sculpture Society, New York, requesting the Society to become a member of same.

Letters of acknowledgment were received from the Hungarian Academy of Sciences, Budapest (138–141); Literary and Historical Society, Quebec, Canada (96–141, and Catalogue, Parts i–iv).

Letters of acknowledgment (142) were received from the Nova Scotia Institute of Science, Halifax; Mr. Horatio Hale, Clinton, Ontario; Geological Survey, Ottawa, Canada; Literary and Historical Society, University Laval, Quebec, Canada; Canadian Institute, Toronto, Canada; Manitoba Historical and Scientific Society, Winnipeg; Bowdoin College Library, Brunswick, Me.; Society of Natural History, Maine Historical Society, Portland, Me.; Dartmouth College Library, Hanover, N. H.; Vermont Historical Society, Montpelier; Massachusetts Historical Society, State Library of Massachusetts, Boston Society of Natural History, Boston Athenæum, Prof. T. M. Drown, Messrs. S. P. Sharples, Robert C. Winthrop, Boston, Mass.; Museum of Comparative Zoölogy, Prof. Alexander Agassiz, Mr. Robert R. Toppan, Cambridge, Mass.; Essex Institute, Salem, Mass.; Prof. Elihu Thomson, Swampscott, Mass.; Dr. James Ellis Humphrey, Weymouth Heights, Mass.; American Antiquarian Society, Worcester, Mass.; Rhode Island Agricultural Station, Kingston; Providence Franklin Society, Brown University, Rhode Island Historical Society, Providence, R. I.; Mr. George F. Dunning, Farmington, Conn.; Connecticut Historical Society, Hartford;

Yale University, Profs. O. C. Marsh, H. A. Newton, New Haven, Conn.; Prof. James Hall, Albany, N. Y.; Society of Natural Sciences, Buffalo, N. Y.; Prof. Edward North, Clinton, N. Y.; Prof. J. M. Hart, Ithaca, N. Y.; Historical Society, Academy of Medicine, New York Hospital, American Museum of Natural History, Meteorological Observatory, University of the City of New York, Profs. J. A. Allen, Isaac H. Hall, J. J. Stevenson, Messrs. Thomas C. Clarke, Charles P. Daly, James Douglas, New York, N. Y.; Prof. W. LeConte Stevens, Troy, N. Y.; Vassar Brothers' Institute, Poughkeepsie, N. Y.; Geological Society of America, Academy of Science, Rochester, N. Y.; Oneida Historical Society, Utica, N. Y.; Free Public Library, Jersey City, N. J.; Prof. Robert N. Rogers, Madison, N. J.; New Jersey Historical Society, Newark; Profs. Charles W. Shields, Charles A. Young, Princeton, N. J.; Prof. Charles F. Hines, Prof. Lyman B. Hall, Haverford, Pa.; Messrs. Charles H. Cramp, Louis Vossion, Samuel Wagner, Mrs. Helen Abbott-Michael, Philadelphia; Smithsonian Institution, United States Geological Survey, Surgeon-General's Office, United States Coast and Geodetic Survey, Weather Bureau, Col. Garrick Mallery, Prof. Charles A. Schott, Drs. John S. Billings, W. J. Hoffman, Mr. William B. Taylor, Washington, D. C.; Enoch Pratt Free Library, Maryland Institute, Prof. Ira Remsen, Baltimore, Md.; Mr. Thomas Leiper Patterson, Cumberland, Md.; Journal of the United States Artillery, Fortress Monroe, Va.; Prof. J. W. Mallet, University of Virginia, Elisha Mitchell Scientific Society, Chapel Hill, N. C.; Agricultural Experiment Station, Raleigh, N. C.; Georgia Historical Society, Savannah; University of Alabama, University P. O.; Texas Academy of Science, Austin; Agricultural Experiment Station, Knoxville, Tenn.; Prof. E. W. Claypole, Akron, O.; University of Cincinnati, Cincinnati Observatory, Cincinnati, O.; Editor of *The Journal of Neurology*, Granville, O.; Gen. W. F. Raynolds, Detroit, Mich.; Geological Survey, Jefferson City, Mo.; Purdue Experiment Station, Lafayette, Ind.; Society of Civil Engineers, Remington, Ind.; Academy of Natural Sciences, Davenport, Ia.; State Historical Society,

Iowa City, Ia.; University of California, Berkeley; Lick Observatory, Mt. Hamilton, Cal.; Prof. J. C. Branner, Palo Alto, Col.; Prof. Daniel Kirkwood, Riverside, Cal.; Prof. George Davidson, San Francisco, Cal.; Kansas University Quarterly, Lawrence; Kansas Academy of Science, Topeka; Academy of Sciences, Arts, and Letters, State Historical Society, Madison, Wis.; State Historical Society, Agricultural Experiment Station, Lincoln, Neb.; University of Wyoming, Laramie; Academy of Science, Tacoma, Wash.; Lieut. A. B. Wyckoff, North Lakima, Wash.; Central Meteorological Observatory, Sociedad-Cientifica "Antonio Alzate," Dr. Antonio Peñafiel, Mexico, Mexico; Agricultural Experiment Station, Las Cruces, N. M.

Accessions to the Library were reported from the Royal Society of South Australia, Adelaide; Prof. A. W. Bickerton, Christchurch, N. Z.; Société Impériale des Naturalestes, Moscow, Russia; Académie Impériale des Sciences, St. Petersburg, Russia; Section für Naturkunde des O. T. C., Anthropologische Gesellschaft, Vienna, Austria; K. P. Meteorologische Institut, Berlin, Prussia; Deutsche Gesellschaft für Anthropologie, etc., Munich, Bavaria; École Nat. Sup. des Mines, Bureau des Longitudes, Société Française de Physique, Paris, France; Philological Society, Cambridge, Eng.; Geographical Society, Literary and Philosophical Society, Manchester, Eng.; Massachusetts Institute of Technology, Boston, Mass.; Harvard College, Cambridge, Mass.; Scientific Association, Meriden, Conn.; College of Physicians, Historical Society of Pennsylvania, Messrs. Henry Phillips, Jr., Frederick Prime, Philadelphia; Smithsonian Institution, Citizens' Association of the District of Columbia, Civil Service Commission, Washington, D. C.; Prof. Alexander Macfarlane, Austin, Texas.; Historical Society of Southern California, San Francisco; Prof. J. P. Walton, Muscatine, Ia.; Institute of Jamaica, Kingston; Agricultural Experiment Stations, Amherst, Mass.; Geneva, N. Y.; Experiment, Ga.; Baton Rouge, La.; Fort Collins, Colo.; Las Cruces, N. M.

Photographs for the Society's Album were received from

Dr. George R. Morehouse, Messrs. William V. McKean and Robert Patterson.

Dr. Rothrock read a paper on "The Present Condition and Future Prospect of the Pennsylvania Forests."

Dr. Morris corroborated the destruction of timber by insects as referred to in Dr. Rothrock's paper.

Dr. Morris read the following communication on "Tuberculosis in Animals:"

Some months since I was present at the slaughter of a herd of cattle on account of a dread of their being tainted with tuberculosis. This disease had been diagnosed as present in the original herd more than two months previously and all suspected animals had then been killed. The farmer, however, was not satisfied that the disease had been stamped out, and preferred to have the rest slaughtered while still in good condition for food as determined by experts who were present. In the lungs of two of them a few hard nodules were found, and on the intestinal walls of nearly all were small round masses which, on being incised, gave vent to a greenish, gritty, cheesy mass. In the opinion of the veterinary surgeon who was present these were not tubercular. They reminded me more of such small, cheesy masses as are often found in human post-mortem examinations and are apt to be disregarded unless found abundantly in subjects of true miliary tubercle when we often consider them as proof that the disease has become disseminated through the entire organism. With these exceptions, and also the occurrence of numerous vascular, subcutaneous lymphatics (called "beans" by the butcher boys), the cattle showed no disease, but, on the other hand, compared favorably with some Western steers which were slaughtered at the same time. The veterinary above mentioned called my attention to the comparative absence of these "beans" and small, yellowish-white bodies in the Western grain-fed stock, and attributed their frequent or almost universal occurrence in Eastern cattle to something in the food or pasture grounds or water used by our cattle. This has set me to thinking whether there may not be some filaria or other intestinal parasite which causes such spurious cyst-like formations. But while waiting for opportunity to investigate this more closely, a gentleman observed to me that some gypsy boys whom he had played with in his youth had shown him a bottle which they said contained a poison prepared from mouldy hay, capable of producing sickness of a lingering, wasting character, terminating in death—like consumption in general character. Immediately the idea occurred to me that we *may* find in this direction the true nature and mode of action and dissemination of tubercle in the human family. The extent of its association with the "bacillus tuberculosis" has led most observers to consider the latter as standing in causal relation to the

disease. Now this is a microscopic fungus; and it therefore seems to me there is no *à priori* improbability of its existence in musty hay and fodder; and when we consider the condition of food given to much of the live stock by improvident and unthrifty farmers a ready explanation of the spread of the disease now so generally dreaded is at hand. In speaking on the subject with Dr. Samuel G. Dixon, the distinguished bacteriologist, I found him fully alive to the possibilities of fruitful results from investigations into the transplantation of fungoid and actino-mycoid growths from a vegetable basis to animals; and that some German authorities have already done good work in this direction. Observations tending to establish an identity between the bacillus tuberculosis and other fungoid growths could not fail of being most important aids to us in combating the dread disease which sweeps away such a large portion of the human race. Nor should we forget that during the late war of the Rebellion a very fatal epidemic of "spotted fever," "black measles" or cerebro-spinal meningitis, as it was called, broke out among soldiers who were supplied with mouldy hay which was used for bedding. The epidemic spread by contagion quite extensively.

I have also been informed that the disease among horses known as cerebro-spinal meningitis is clearly traceable to mouldy hay; among the Dutch farmers near Lancaster it is called "putrid sorethroat," because the mucous membrane of the throat becomes inflamed and gangrenous, and the bolus of food is not swallowed, owing to paralysis of the muscles of deglutition We have thus as it were a connecting link with the phenomena of diphtheria, which is also traced to a mould or fungus which may grow upon any abraded, moist or mucous surface. The tendency of pathological investigations and studies during the past twenty years has been more and more towards the discovery of intimate causal relations between many diseases not formerly recognized as zymotic, and corresponding fungi or "bacteria" or "bacilli." We forget too often that these are only terms for microscopic fungi or moulds: that the same laws of propagation and growth govern them as their larger congeners: that the very term "zymotic" so long used in medical literature shows that our predecessors properly classed them as the results of "ferments:" and thus are liable to be led away from true methods of checking their ravages. Undoubtedly these are to be sought by better acquaintance with their life-conditions: and a large step in advance will have been made if we should be able to trace them from their ordinary and comparatively innocuous vegetable *habitats* to their dangerous migrations to animals. I do not know that in this connection attention has been drawn to the typhus-fever epidemics which have followed extensive vegetable disease, *e. g.*, the Irish potato rot: or the effect of ergotized rye and wheat on the poorer classes in Italy and the Balkan provinces. To return to the subject of tuberculosis in animals, including man: the conditions for its virulent spread are eminently those favoring fungous growths—deficient vital force (whether original or acquired from overstrain), damp dwellings, overheated viti-

ated air, and insufficient food. Add to these the germ, and the result is not long in showing itself. Take these away, and the germ is harmless, comparatively. A good illustration of this is to be found in the animals, especially the monkeys crowded together in our zoölogical gardens. What better field could be found for a properly conducted series of experiments on the thorough disinfection of air and food; isolation of infected individuals; and curative agents? The latter should embrace such bactericides as can enter the circulation harmlessly, and such natural food as will sustain the animals. The late Dr. Shippen's experience with the lessening of tuberculous and scrofulous disease among the colored inmates of the House of Refuge after the introduction of cornmeal as a large part of their diet should not be lost sight of. Might not a diet of cocoanuts and palmnuts be useful to our monkeys?

In conclusion, I would urge upon our microscopists the study of the whole class of moulds and fungi, both in their usual forms, and as to their transplanted forms in animal media and in living animals.

Pending nominations Nos. 1273 and 1274 were read.

On motion, it was

Resolved, That Rev. Robert W. Rogers, Ph.D., be appointed a delegate to represent the Society at the Congrés Internationale des Orientalistes, to be held at Geneva, in September, 1894, providing that the same shall entail no expense whatever upon the Society.

And the Society was adjourned by the President.

Stated Meeting, March 16, 1894.

Dr. J. CHESTON MORRIS in the Chair.

Correspondence was submitted as follows:

A letter accepting membership from Sir Henry Bessemer, London, Eng.

An invitation from the Maryland Historical Society, Baltimore, to attend its Fiftieth Anniversary, March 12, 1894.

Letters of envoy were received from the Geological Survey of India, Calcutta; Société des Naturalistes, Moscow, Russia; K. Sächsiche Gesellschaft der Wissenschaften, Leipzig; Société d'Histoire Naturelle, Strassburg, Alsace.

Letters of acknowledgment were received from the K. K. Sternwarte, Prague, Bohemia (141); Société d'Histoire Naturelle, Strassburg (140, 141); Prof. Abel· Hovelacque, Paris, France (141); Dr. Traill Green, Easton, Pa. (142); Prof. John F. Carll, Pleasantville, Pa. (142); Mr. Jedediah Hotchkiss, Staunton, Va. (142); Scientific Society, Denver, Colo. (142); Central Meteorological Observatory, Mexico, Mexico (140, 141); Observatorio Astrónómico Nacional Mexicano, Tacubaya (142); Instituto fisico-geografico Nacional, San José de Costa Rica, C. A. (141); Museo Nacional, Buenos Aires, S. A. (139, 140, 141).

Accessions to the Library were reported from the Geological Survey of India, Calcutta; Statistica Central Byran, Stockholm, Sweden; K. K. Zoologisch-botanische Gesellschaft, Prof. Karl Penka, Vienna, Austria; Gesellschaft für Erdkunde, Berlin, Prussia; Naturforschende Gesellschaft, Freiburg i. B.; Société d'Histoire Naturelle, Strassburg, Alsace; Naturforschende Gesellschaft, Zurich, Switzerland; "Il Nuovo Cimento," Pisa, Tuscany; Université de Lyon, France; Instituto y Observatorio de Marina, San Fernando, Spain; R. Meteorological Society, London, Eng.; Royal Society, Edinburgh, Scotland; Theological Seminary, Andover, Mass.; Commission of Public Records, Boston, Mass.; Mr. Walter S. Logan, New York, N. Y.; Hon. Robert E. Pattison, Harrisburg, Pa.; Dr. C. S. Dolley, Philadelphia; California Academy of Sciences, San Francisco; Historical Society, Chicago, Ill.; Experiment Stations, Raleigh, N. C.; Ames, Ia.; Lincoln, Neb.; Corvallis, Oreg.

The death of Cavaliere Damiano Muoni, Milan, Italy, February 22, 1894, æt. 74, was announced.*

* Cavaliere Damiano Muoni was born at Antignate, Province of Bergamo, Italy, on the fourteenth day of August, 1820. His early life was studious, and his ambitions patriotic. He participated in the ill-starred insurrection, "le cinque giornate," of 1848, at Milan, and in consequence was obliged to be absent from his country for a long period. His time was filled with study, and he returned the possessor of much valuable historical and archæological matter. His activity in authorship was unceasing, and over one hundred books, pamphlets, papers, etc., attest his proficiency in history, genealogy, archæology, fine arts, and other branches of knowledge. He held the position of State Archivist for many years, and was zealous, courteous and obliging.

Mr. Henry C. Baird read a paper entitled "Association: The Dominating Need of Man, and the Keystone of Social Science."

After which a desultory discussion on the subject of the paper took place.

Pending nominations Nos. 1273 and 1274, and new nominations Nos. 1276 to 1296 inclusive were read.

And the Society was adjourned by the presiding member.